75th Year of editorial service to power progress

Power

A McGRAW-HILL PUBLICATION MAY 1957 • ONE DOLLAR

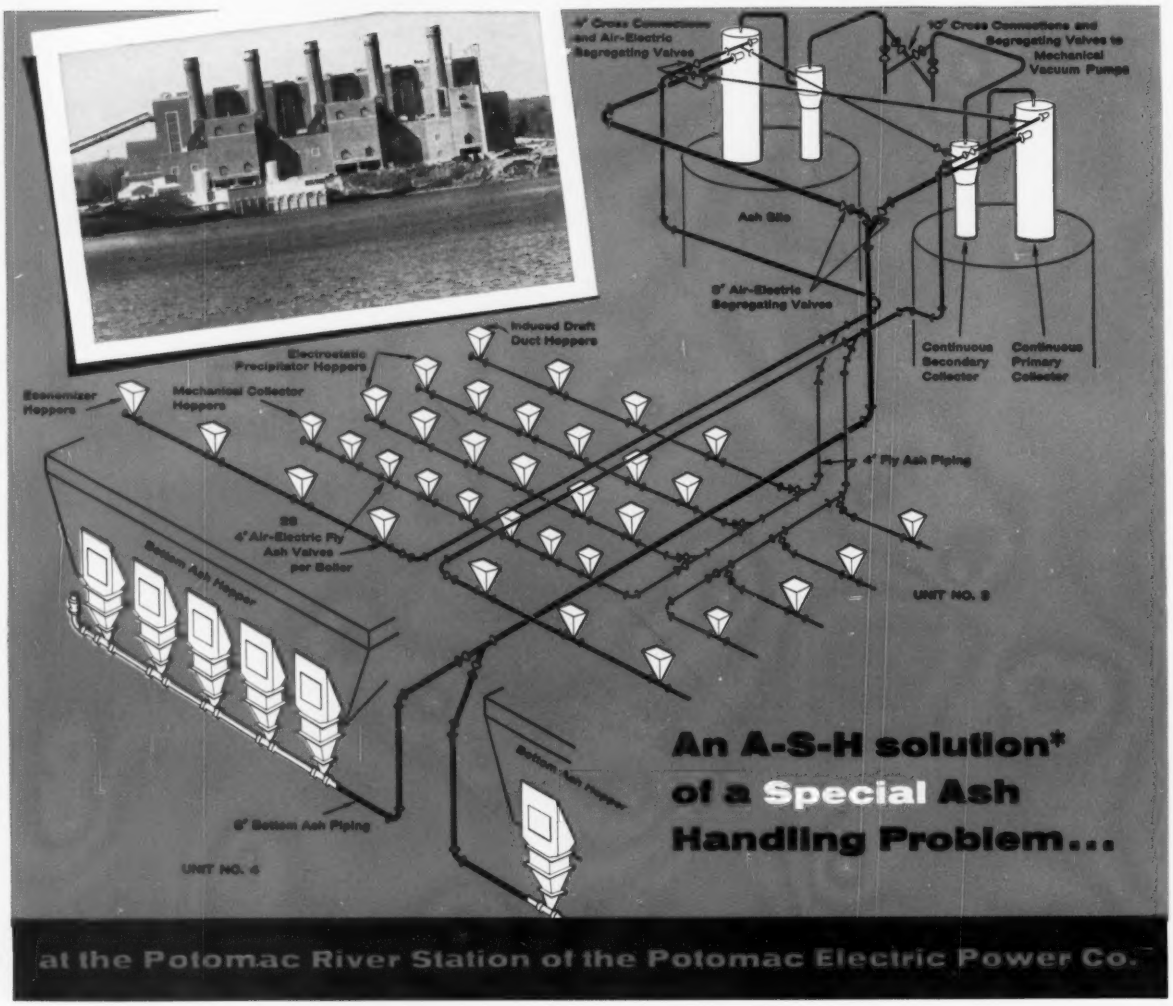
Motor control can be a PTG factor..... 96

Water treatment for packaged boilers..120

A new twist on steam trap maintenance . 122

Is in-plant corona testing practical?....132

→ Belts and Chains: A 20-p report ▸ 75


Ash Silo
Induced Draft Duct Hoppers
Electrostatic Precipitator Hoppers
Economizer Hoppers
Mechanical Collector Hoppers
4" Fly Ash Piping
Bottom Ash Hopper
6" Bottom Ash Piping
UNIT NO. 6
UNIT NO. 5
Continuous Secondary Collector
Continuous Primary Collector
An A-S-H solution* of a Special Ash Handling Problem...
at the Potomac River Station of the Potomac Electric Power Co.

At the Generating Station pictured above, cleanliness is of vital importance. It is located across the Potomac from our Nation's Capital in the popular residential area of many Washington executives and officials in Alexandria, Virginia.

A-S-H Engineers assured cleanliness in ash removal with this versatile, automatically controlled sealed system. Is it successful? As Potomac Electric expanded their facilities to an effective capacity of 493,000 kw, they *added* additional *A-S-H units.*

Notice, in the schematic drawing of two of their five units, how maximum versatility has been achieved. Each steam generating unit has its own ash handling system. But take special notice of the cross connections in the piping, with these advantages:

1. Each unit can operate independently, collecting both fly and bottom ash in its own silo;
2. All ash from both units can be collected in either of the silos alone;
3. Fly ash from both units can be collected in either silo; bottom ash can be collected simultaneously in the other.

The experience that went into the solution of Potomac Electric's problem can be put to work for you. Your "special" problem is not too hard, too big or too small. It is important, to both of us, and we'll give it prompt attention. Describe your problem, and we'll rush you helpful data or arrange for a competent field engineer to call.

* *A-S-H service doesn't stop with installation. When service problems come up, we stand ready to give prompt service assistance. This is a policy worth considering when suppliers are being selected.*

MATERIALS HANDLING SYSTEMS

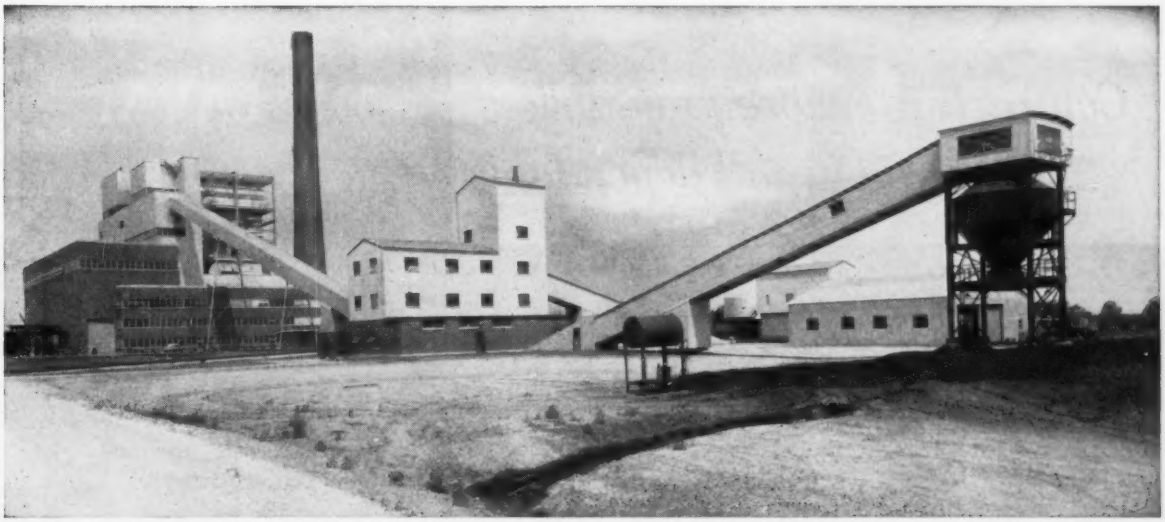
"Hydrojet" *hydraulic*

"Hydrovac" *pneumatic*

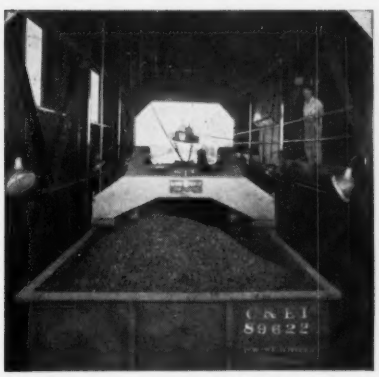
the **Allen-Sherman-Hoff** company

259 E. Lancaster Ave., Wynnewood, Pa.

Offices and representatives in principal cities

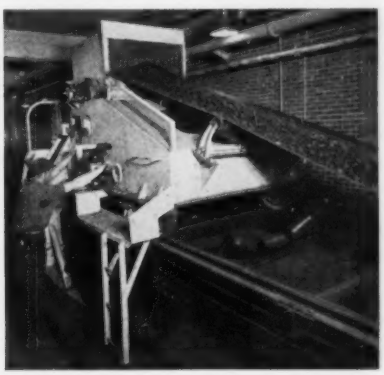


VERMILION STATION power plant, Danville, Ill., employs a Link-Belt system for fast, economical conveying and processing of coal.



LINK-BELT CAR SHAKER with exclusive, low-frequency vibration quickly frees packed coal—empties hopper bottom cars fast.

INCLINED BELT CONVEYOR, 30-in. wide, delivers coal to top of bunkers where it is discharged to distributing belt conveyor.



DISTRIBUTING BELT CONVEYOR with *self-propelled* tripper discharges coal to bunkers through dust-tight bin seal.

33% EXPANDABILITY

built into Vermilion Station's coal handling system

LINK-BELT engineering and equipment provide for future load increase

RAPID growth of population and industry—with corresponding need for more electricity—is a vital consideration in modern power plant design. That's why Illinois Power Company, in planning the Vermilion Station, sought an efficient coal handling system that could satisfy expected expansion.

Link-Belt, with its cumulative experience gained in thousands of similar installations, was selected for the project. And, working with Sargent and Lundy, consulting engineers, furnished a complete coal handling system able to process 300 tph . . . with provision to easily increase capacity to 400 tons when needed.

This plant is just one of many benefiting from the proved effectiveness, the maximum simplicity and economy of Link-Belt equipment. For all your coal handling problems—unloading, storing, weighing, reclaiming, elevating, feeding—Link-Belt can supply a low-cost-per-ton solution.

You can get full information at your nearest Link-Belt office or from Book 2410. It shows the latest layouts and equipment for power plants, large and small.

14,278

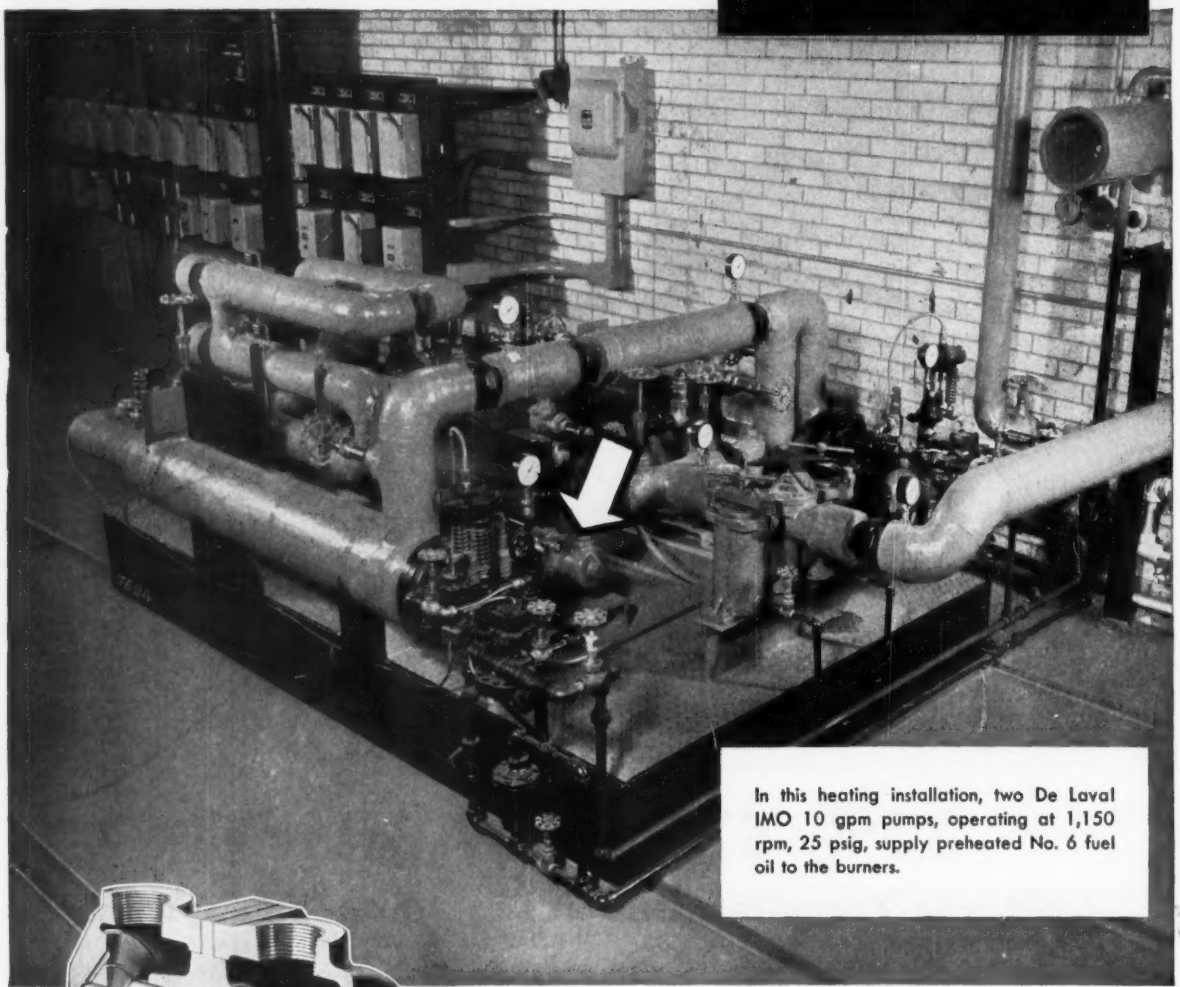
LINK-BELT

COAL HANDLING EQUIPMENT

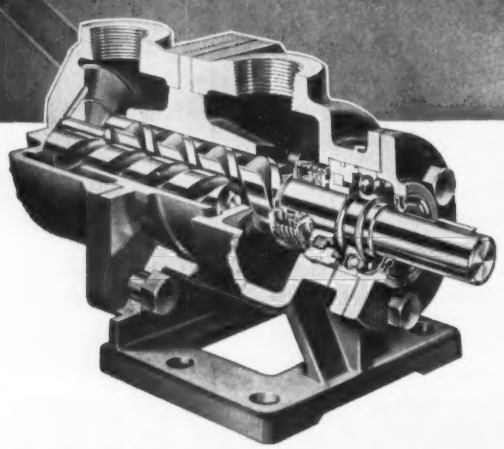
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

Contracts are more profitable when you install dependable

DE LAVAL
IMO PUMPS



In this heating installation, two De Laval IMO 10 gpm pumps, operating at 1,150 rpm, 25 psig, supply preheated No. 6 fuel oil to the burners.



A wide range of De Laval IMO models specifically built for fuel oil service is available. Capacities up to 80 gpm, pressures to 275 psig. Write today for Bulletin LG-A.

To increase your present—and future—profits on commercial heating jobs, install *dependable* De Laval IMO pumps on pump and heater sets. Their simple, trouble-free design saves you money on service calls. . . builds customer goodwill, for there's nothing to get out of order or need adjustment. No pilot gears, no sliding vanes, no reciprocating pistons. De Laval IMO's have only three moving parts—smoothly intermeshing rotors that propel the fluid axially in a steady flow without churning, pocketing or pulsation.

DE LAVAL *IMO Pumps*

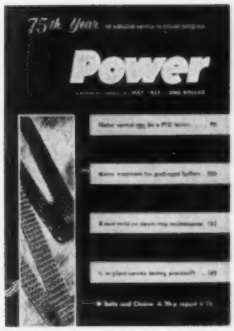
DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL272

Power

MAY 1957 • VOLUME 101 NUMBER 5



ENGINEERING AND MANAGEMENT

BELTS AND CHAINS: A 20-page special report 75
Today's belt materials and designs give top performance 78
Five chain types meet modern power-transmission needs 88
Nuclear notes: News of latest developments 95
Motor controls: No. 9 in the PTG . . . *electrically* series 96
Smart design makes Sikorsky's power plant a standout 99
Control boiler feedwater silica with these proven methods 102
Gas processes for harnessing energy: Thermo refresher No. 8 106
Preparing for the future: A never-ending assignment 110
Data sheet: Air-temperature rise through forced-draft fans 111

PLANT OPERATION AND MAINTENANCE

Three sure ways to control piping vibration 115
Here's selective plating—your new maintenance tool 118
22 Q&A's on feedwater treatment for packaged boilers 120
Now, temperature-indicating crayons for steam-trap testing 122
Should you invest in an air-conditioning service contract? 124
A quick review of the fundamentals of storage-tank venting 128
Hydro station self-cleaning racks keep intakes clear 130
Consider corona testing as a new maintenance technique 132
Fact file: Five rectifiers and their applications 134
Practical ideas 136
Plant problems 142
Arguments 148
How-to: Bore chatterless holes 150
Basics: Alternating current 152
Marmaduke Surfaceblow 154

READER SERVICE SECTION

This month's service index 158
Reports from the field 160
Technical briefs 162
Plant equipment news 166
New free literature 175
George Edwards 178

Print order this issue: 49,436

ARTICLES LISTED on this month's cover run the gamut from electrical in-plant testing to the best approach for water treatment of packaged boilers; much akin to the range of problems faced by the power-service engineer in his daily job.

The Power-to-Grow feature delves into the matter of motor controllers—an area often missed in PTG planning. For some why's and how's, check page 96.

Next month . . .

Heat pumps, in most cases, are no longer too costly for cold climates. New designs, plus a gradual shift to relatively lower-cost electrical power, are making them more desirable. June's lead story reviews today's designs, talks about trends that promise to make this summer-cooling winter-heating technique a major power-service system.

Industrial lighting gets a 5-page treatment in June. Fact-filled article tells how to pinpoint costs and make comparisons between different low-mounted fluorescent types and high-mounted fluorescent, mercury and incandescent systems.

One modern steam plant eliminates five existing plants, plus two other contemplated plants. And at annual savings of about $70,000. Interested? Full story is coming your way next month.

. . . and a future month

Standard motors are generally your best bet—but nonstandard units also present an interesting case. Future article looks at both sides of problem.

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer)* is published monthly by McGraw-Hill Publishing Company, Inc, James H McGraw (1860-1948), Founder, PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W 42nd St, New York 36, N. Y. See panel below for directions regarding subscriptions or change of address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W 42nd St, New York 36, N. Y. Donald C McGraw, President; Joseph A. Gerardi, Executive Vice-President and Treasurer; John J Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B Smith, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising Sales; A R Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of power, light, heat and other plant services in utilities, construction firms, industrial and service plants. **Position and company connection must be indicated on subscription orders. Send to address shown in box below.**

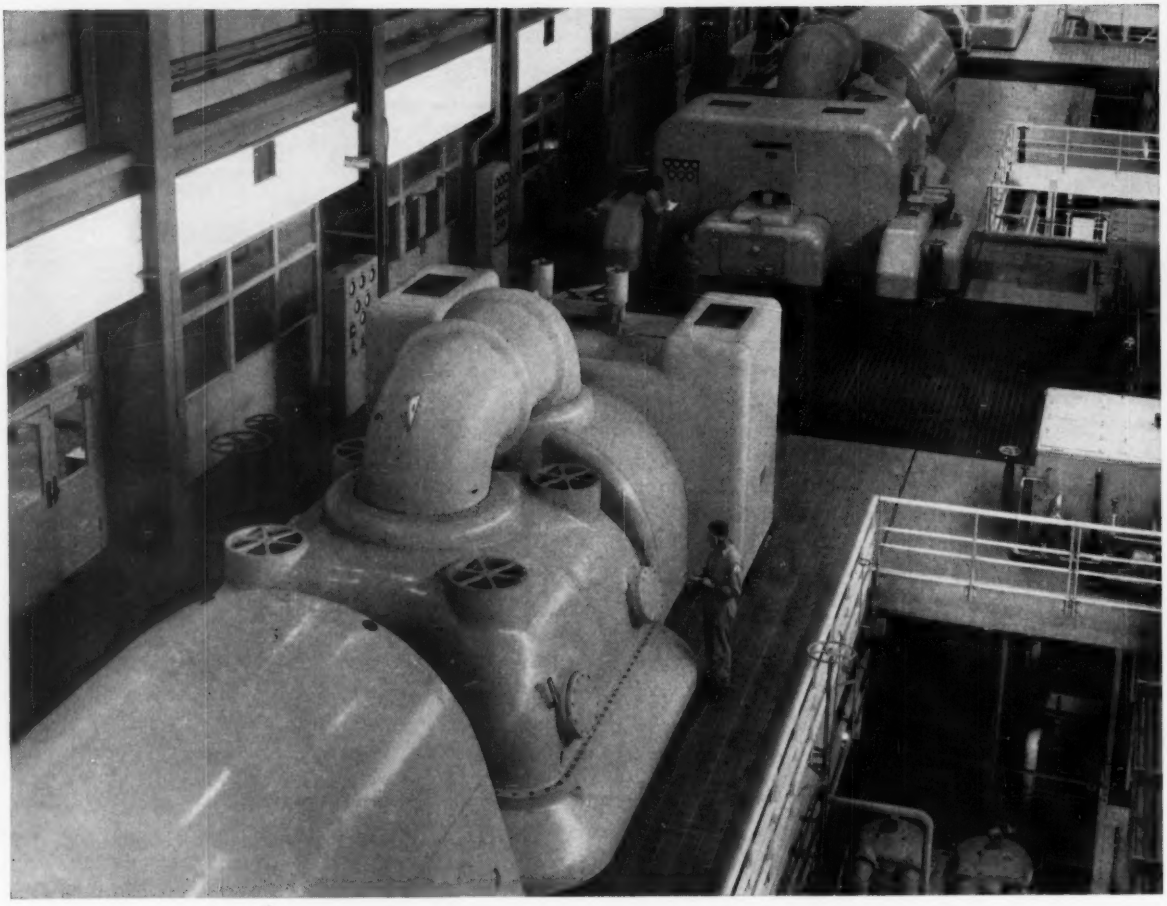
United States subscription rate for individuals in the field of the publication $4.00 per year, single copies $1.00. Canada; $6.00 for one year. Foreign; $15.00 for one year. Second-class mail privileges authorized at New York, N. Y. Printed in U.S.A. Title registered in U.S. Patent Office.

©. Copyrighted 1957 McGraw-Hill Publishing Company, Inc, all rights reserved.

Power articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index, obtainable on request to the Editor. Notice of availability appears in POWER.

SUBSCRIPTIONS: Send subscription correspondence and change of address to Subscription Manager, POWER, 330 W 42nd St, New York 36, N. Y. Subscribers should notify publisher promptly of any change of address, giving old as well as new address, and including postal zone number, if any. If possible, enclose an address label from a recent issue of the magazine. Please allow one month for change to become effective.

Postmaster: Please send form 3579 to POWER, 330 W 42nd St, New York 36, N. Y.



To keep turbine performance at an efficient high

Texaco Regal Oil R&O

Regardless of operating conditions, turbines lubricated with *Texaco Regal Oil R & O* can be depended upon to perform efficiently under peak and valley loads alike.

The reasons for the superiority of *Texaco Regal Oil R & O* over ordinary turbine oils are compelling:

- It prevents sludge, rust and foam, assures normal bearing temperatures and instantaneous governor response.
- It meets the exacting requirements of all leading turbine builders regardless of turbine type, size or special features.

With *Texaco Regal Oil R & O* you can count on extra-strong protection throughout an extra-long service life.

A Texaco Lubrication Engineer is trained to help you select the right turbine oil from Texaco's complete line of *Regal Oils R & O*. Just call the nearest of more than 2,000 Texaco Distributing Plants in the 48 States—or write The Texas Company, 135 East 42nd Street, New York 17, New York.

TEXACO

TEXACO Regal Oils R & O

FOR ALL TURBINES

speaking of **Power**

Editorial research: The job of digging for facts, old and new

Research for a special report invariably brings to light a host of interesting items that never appear in POWER's pages. Current report, *Belts and Chains*, had its full quota of side bits. While digging into modern belt background, Asst Ed Althea Thornton came up with the observation that today's efficient and precisely made multiple V-belt drive had its origin with the early bow drill, basically the same device our Boy Scouts use to create fire by friction. The Egyptians, she found, used to bow drill as early as 1500 BC to start fires, drill wood or stone.

A further bit of info: Endless belts of chain, rope and rawhide appeared before 200 BC, yet seldom were used to transmit power between shafts until the 15th century. About 1850, an Irish lad named James Combe devised the English system of endless spliced ropes running in multi-grooved pulleys. Combe used the setup to drive machines in his textile mill. The technique proved well-suited to power plants. A refinement of the idea was made by an American, Wallace Dodge. His improvement, basically the continuous wrap system, was devised to provide one continuous rope looped about the grooved pulleys and a traveling idler. The idler provided a practical, yet simple, means of taking up rope slack caused by added load, temperature and humidity changes.

In thumbing through early issues of POWER, an item in the June 1889 issue caught our eye . . . "a recent instance of the use of rope for power-transmission purposes can be seen in the new building of the Western Electric Co, corner of Thames and Greenwich St in New York City. The engines, located in the basement, are two in number with cylinders 18 by 27 in. These engines were built by Russell & Co of Massillon, Ohio. Flywheels are two feet in diameter, grooved for six ropes each and run at the rate of 125 rpm. The rope runs continuously over the pulleys from groove to groove." Illustration accompanying the text shows a rope drive running up through eight floors, driving shafting on each floor.

Big 75th Anniversary Issue, coming in September, has the editorial staff on the move checking design and operating trends. Last month Editor Lou Rowley and staffers Howie Kallen, Norm Peach and Bob Marks, took off for the midwest. Two-fold aim: Attend the American Power Conference; hold a series of meetings with top engineers to get their thinking on present trends in power services. Three separate meetings, starting with an all-morning breakfast confab, were held daily. And this went on for the best part of a week. This procedure will be repeated in other cities. It all adds up to a 75th Anniversary Issue that promises to be a long-remaining significant landmark for power men.

Leaving the door open for a possible follow-up article is part of an editor's stock in trade. Associate Editor Ben Skrotzki did just that in probing the Puerto Rico power picture for the March issue. After the story appeared, Ben received a letter from S L Descartes, Executive Director of Puerto Rico Water Resources Authority . . . "The article shows a good understanding of problems facing the Commonwealth who are engaged in developing a community in which our abundant population can live with dignity and comfort. You saw what has been done to date. If at any time you wish to return for a second look you are welcome."

L N ROWLEY *Editor*

B G A SKROTZKI *Engineering and Management*
S M ELONKA *Operation and Maintenance*
H P KALLEN *Special Projects*
J J O'CONNOR *Managing Editor*
R C BELLAS *Assistant Editor*
R H MARKS *Assistant Editor*
N PEACH *Assistant Editor*
A P SOMMER *Assistant Editor*
A S THORNTON *Assistant Editor*
C F MARSCHALEK *Art Editor*
F A ANNETT *Contributing Editor*

P W SWAIN *Consulting Editor*

DOMESTIC NEWS BUREAUS: *Atlanta, Cleveland, Detroit, Dallas, San Francisco, Washington*

WORLD NEWS OFFICES: *London, Paris, Bonn, Tokyo, Beirut, Rio de Janeiro, Mexico City*

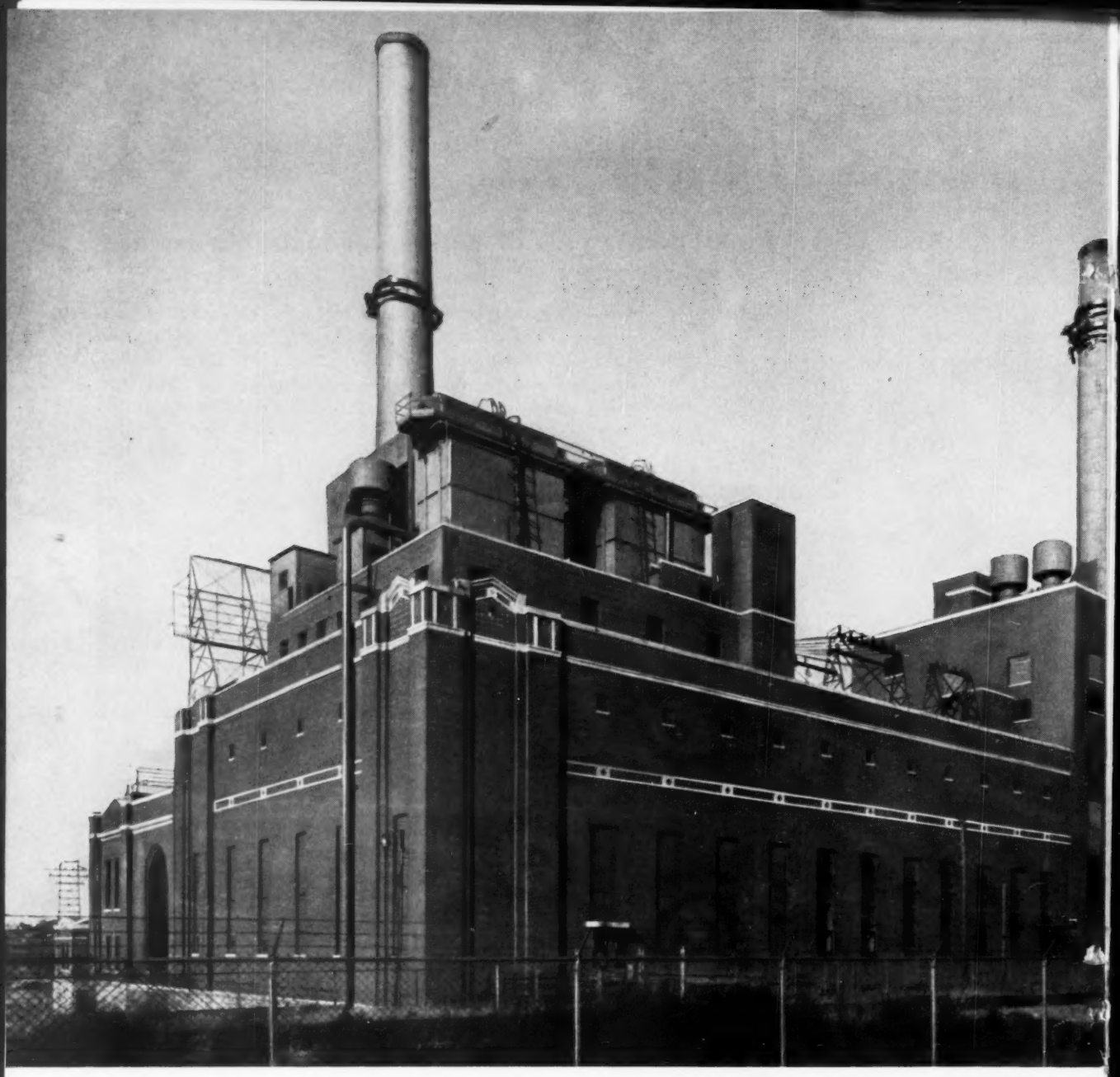
SHELTON FISHER *Publisher*

CLARK BOUGHTON *Sales Manager*

DISTRICT MANAGERS

W R KLEIN, 330 W 42nd St, New York 36, N. Y.
J E DEAN, 330 W 42nd St, New York 36, N. Y.
C R LONG, Architects Bldg, Philadelphia 3, Pa.
L W ROMIGH, 520 N Michigan Ave, Chicago 11, Ill.
J S WENGER, 1510 Hanna Bldg, Cleveland 15, Ohio
G L CRANE, Continental Bldg, St. Louis 8, Mo.
M H MILLER, 801 Rhodes-Haverty Bldg, Atlanta 3, Ga.
D C BILLIAN, The Vaughn Bldg, Dallas 1, Texas
R C ALCORN, 68 Post St, San Francisco 4, Calif.
H L KEELER, 1125 W Sixth St, Los Angeles 17, Calif.

W K PONDER *Circulation Manager*

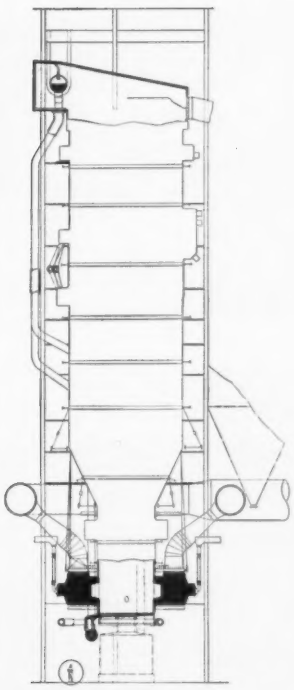


New Cyclone Furnace Unit

Installation at Joliet Station to Bring Higher Efficiency ... Lower Costs to Power Generation

Commonwealth Edison System's newest addition, at its Joliet Station, will be a B&W Radiant Reheat Boiler with Cyclone Furnaces. This is the 16th unit of this type the system has bought since 1944 and raises total system capacity served by Cyclone-fired units to over 1,600,000 kw.

Early in the development of the Cyclone Furnace by B&W, Commonwealth Edison recognized its potentialities for burning low-grade coals. The system's engineers and operators cooperated with B&W in the project, and, in September 1944, the



B&W RADIANT REHEAT BOILER WITH CYCLONE FURNACES, arranged for opposed firing, for Commonwealth Edison System's Joliet Station. Unit will deliver 2,200,000 pounds of steam per hour at 2100 psi with temperature of 1055 F, reheat to 1005 F. Boiler design is 2375 psi. Sargent & Lundy, Consulting Engineers.

CYCLONE FURNACE BOILER UNITS IN COMMONWEALTH EDISON SYSTEM

STATION	NO. OF BOILERS	NO. OF CYCLONES	TOTAL CAPACITY LB/HR	DESIGN PRESSURE	STEAM TEMP. F	REHEAT TEMP. F
Calumet	1	1	150,000	600	650	—
Waukegan	1	2	300,000	650	760	—
Fisk	2	8	1,500,000	1475	935	—
Joliet	2	6	1,200,000	1525	1010	—
Ridgeland	4	16	2,920,000	2125	1050	—
Waukegan	1	4	830,000	2050	1010	1010
Ridgeland	2	12	2,200,000	2125	1050	1000
Will County	2	10	2,400,000	2125	1050	1010
Joliet	1	9	2,200,000	2375	1055	1005
	16	68	13,700,000			

For Commonwealth Edison

first commercial application went on the line at Calumet Station. Historic Boiler Unit No. 20-A, like the new unit at Joliet, burns highly volatile Central Illinois coal with a high ash content and low ash-fusion temperature.

The Cyclone Furnace simplifies the entire process of coal preparation, combustion, ash segregation, and ash handling and effects savings in most of the elements of power generation costs.

In service or on order, 64 boilers with 220 Cyclone Furnaces throughout the country serve a total capacity of over 6,600,000 kw. They merit examination in connection with your next installation. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

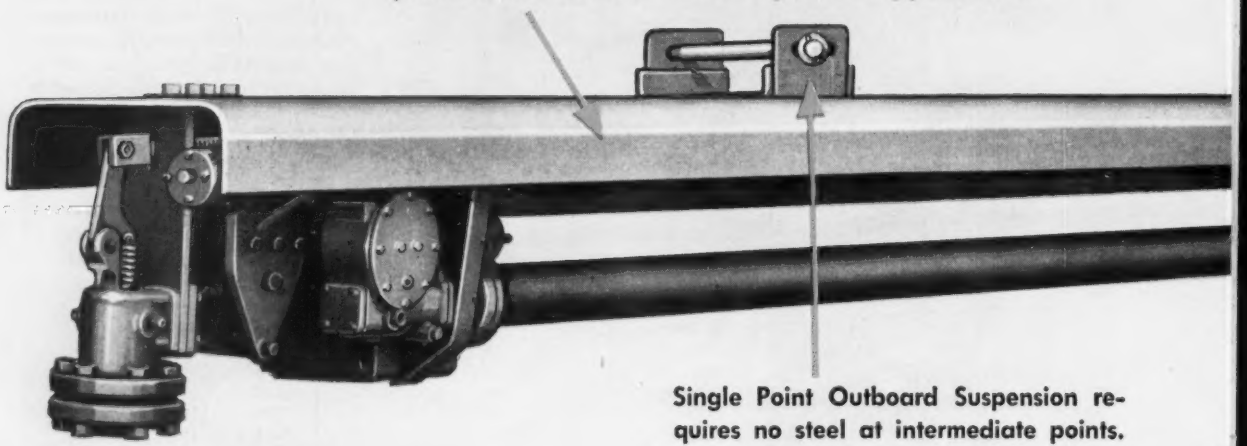
G-820-CS

BABCOCK & WILCOX

BOILER DIVISION

Backbone and Protective Cover

Top Cover is an integral part of the structural "Backbone" of the blower unit that assures greater rigidity. It also provides protection from dirt, damage, the elements, and personnel hazard . . . with improved appearance.



Single Point Outboard Suspension requires no steel at intermediate points.

One of the most popular features of the new Diamond Series 300 IK Long Retracting Blower is the very substantial cover that is formed from steel plate. It is much more than just a cover in the ordinary sense . . . it is also an integral part of the structural backbone of the blower that provides maximum rigidity without excessive weight.

This is only one of many important features (see box on right hand page) of the new Series 300 IK that is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask the nearest Diamond office for Bulletin 2111U.

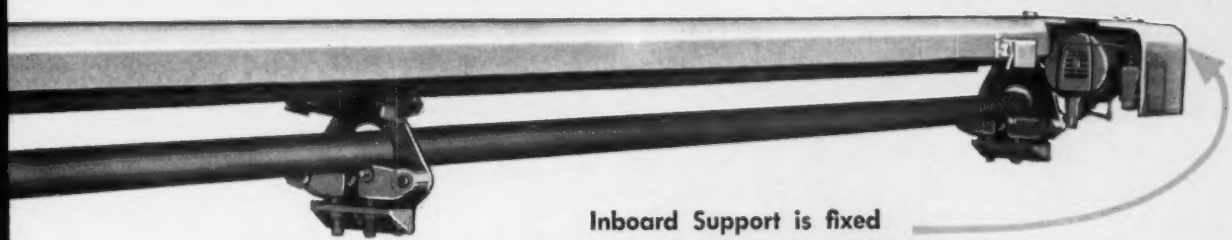
Diamond

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario

ANOTHER IMPORTANT FEATURE of the NEW Diamond SERIES 300 IK LONG RETRACTING BLOWER



Inboard Support is fixed
or from boiler, as required.

"YOU CLEAN BOILERS BETTER AND AT LOWER COST WITH DIAMOND BLOWERS"

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Front End Single-Motor Drive
- Compact, Accessible Electric or Air Power and Control Terminal Facilities
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

7697

WELBOND®

is the valve

for high pressures, high temperatures

Yarway Welbond Valves are available in 9 sizes, ¼" to 2½", angle and straightway designs. Pressures to 2500 psi, temperatures to 1500° F.

Welbond is the valve designed by Yarway specifically to provide modern steam power plants with the ultimate in high pressure, high temperature valve service.

These special Welbond features insure improved valve performance:

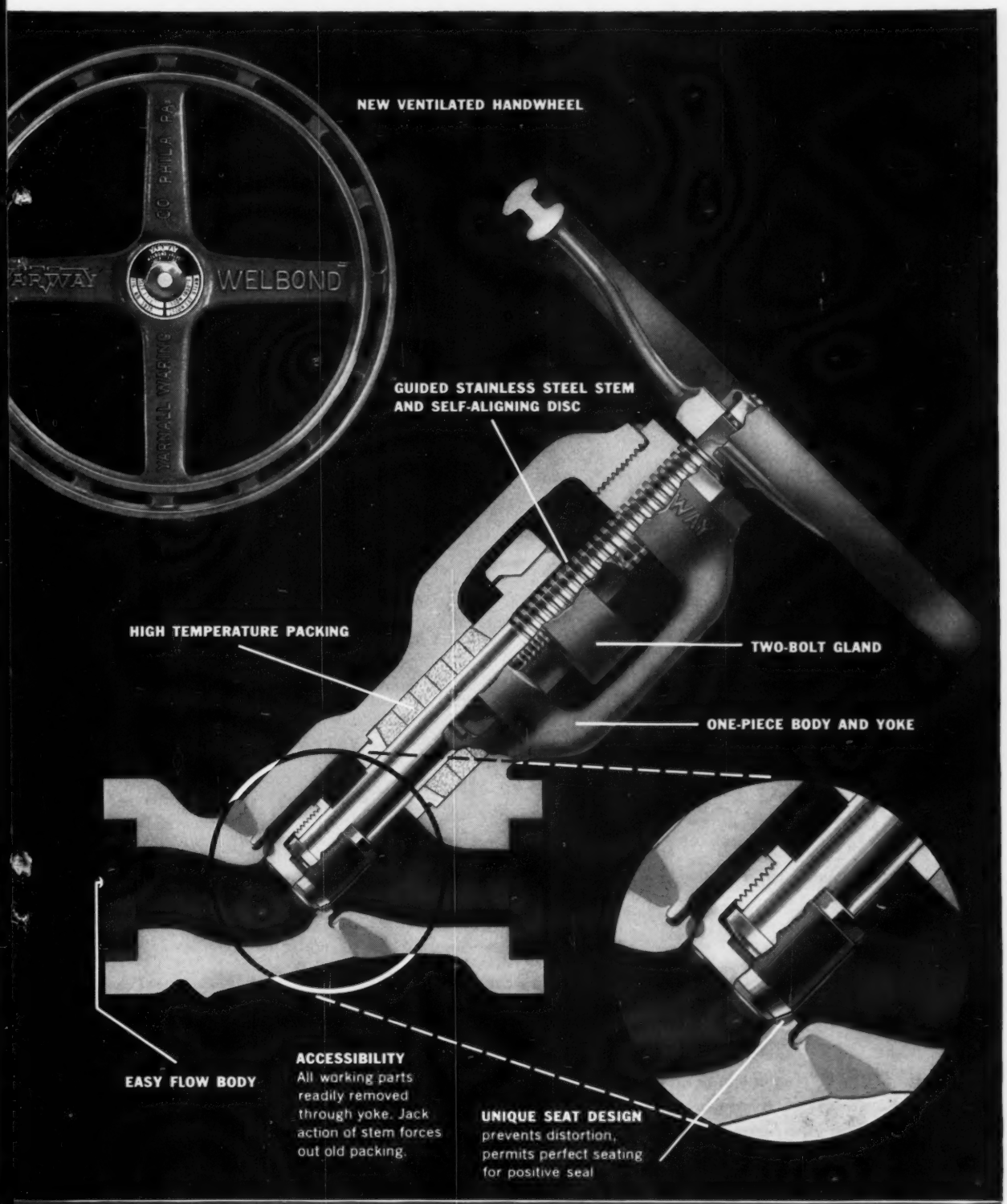
- **Stem** of 321 stainless steel, used with special **packing** to prevent stem corrosion
- Easy and quick **accessibility.** All working parts removable through yoke.
- Non-distorting, thermally-compensated **seat**
- Ventilated, easy grip **handwheel**
- **Streamlined flow** through body

Welbond Valves are winning approval on superheater vents and drains, water wall drains, economizer drains, steam gage shut-off, strainer blow-off and many other steam plant services. Your Yarway man will be glad to discuss applications for your plant.

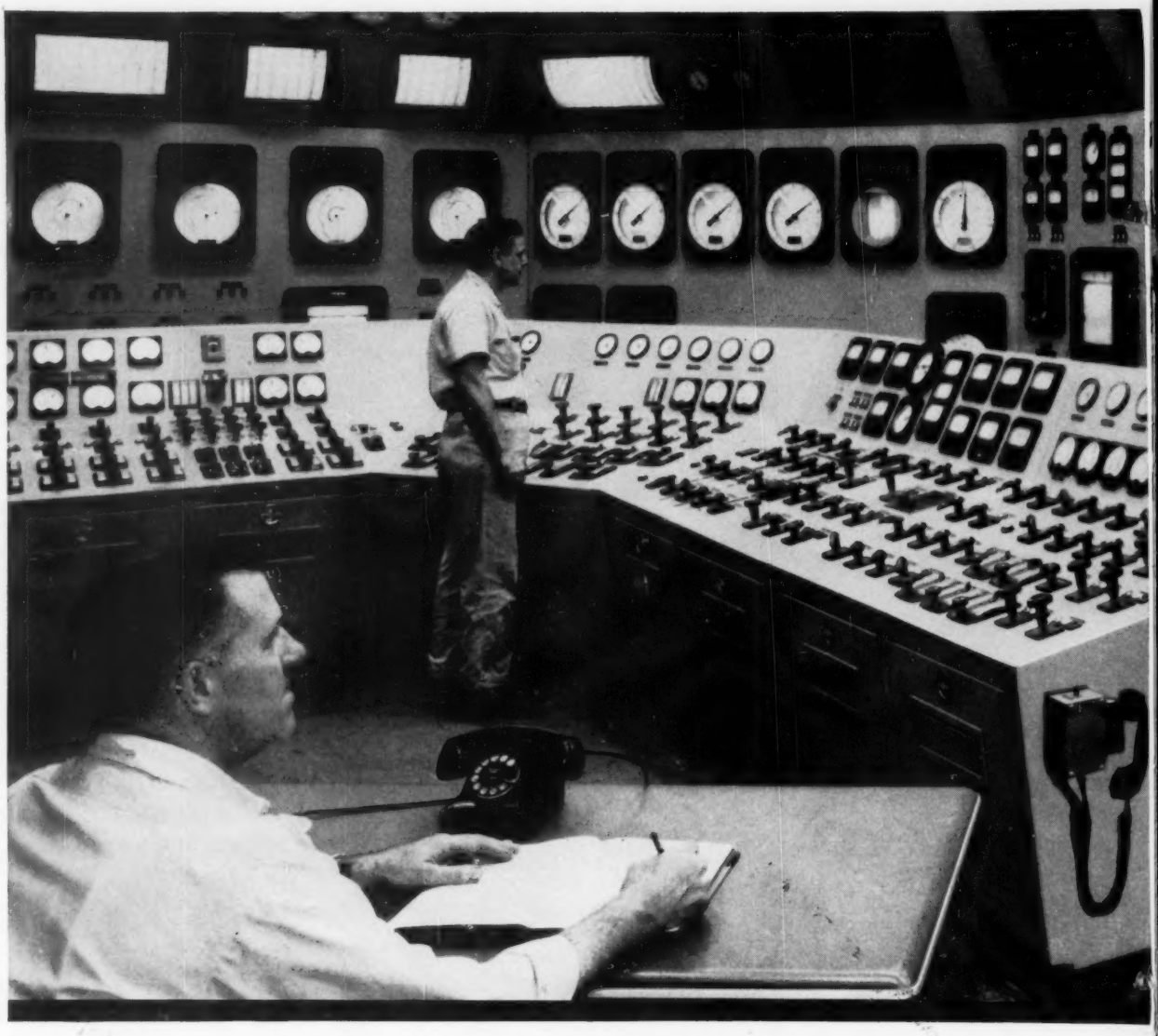
For full information, write for Yarway Bulletin B-452.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® WELBOND . . . a good


NEW VENTILATED HANDWHEEL
WELBOND
GUIDED STAINLESS STEEL STEM AND SELF-ALIGNING DISC
HIGH TEMPERATURE PACKING
TWO-BOLT GLAND
ONE-PIECE BODY AND YOKE
EASY FLOW BODY
ACCESSIBILITY
All working parts readily removed through yoke. Jack action of stem forces out old packing.
UNIQUE SEAT DESIGN
prevents distortion, permits perfect seating for positive seal

way to specify high pressure/high temperature valves



How Bailey makes steam

Fingertip Controls, convenient indicators, and trend recorders make steam control room operating duties a pleasure. You get this bonus for your operators when you specify Bailey Meters and Controls.

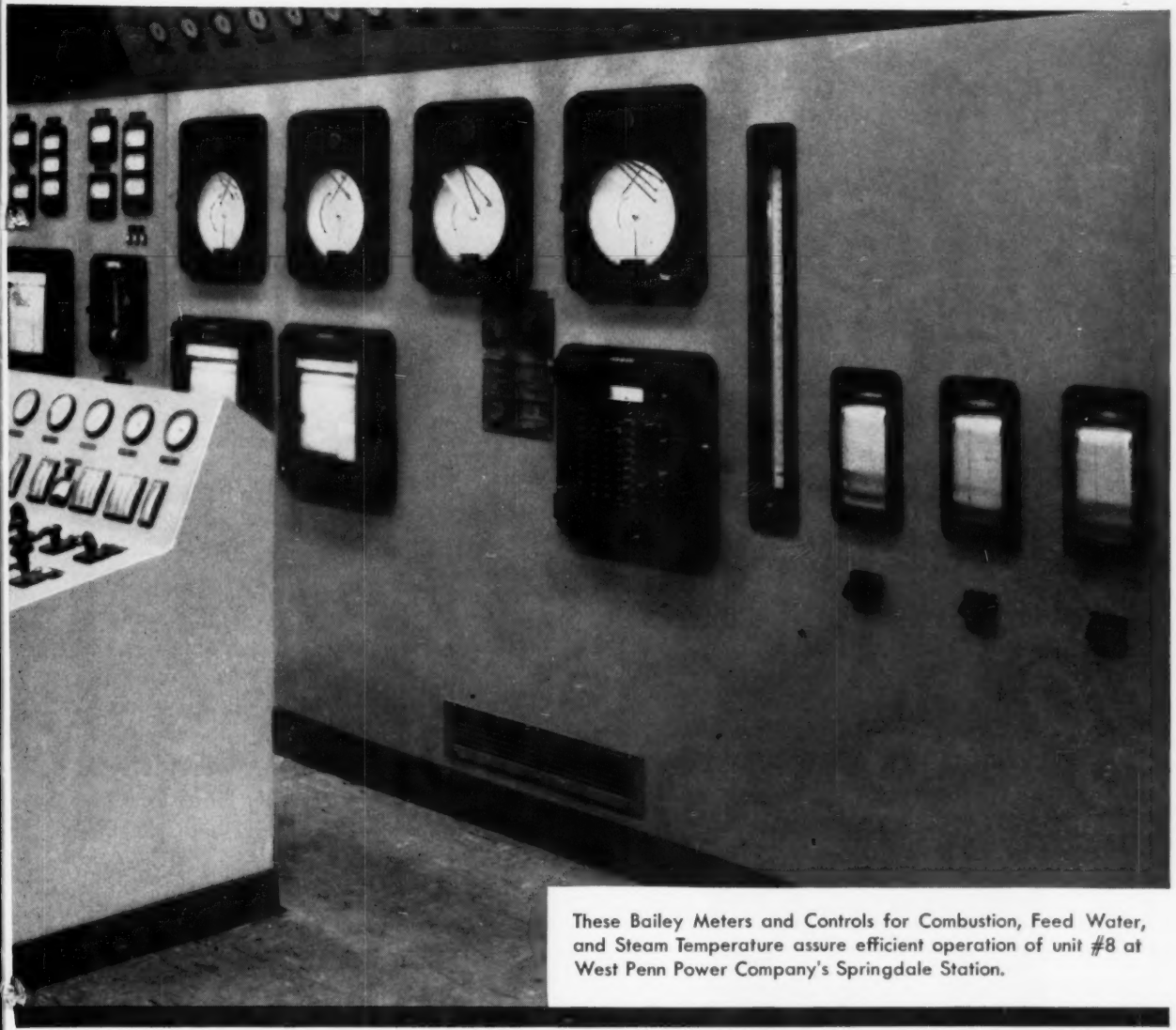
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



These Bailey Meters and Controls for Combustion, Feed Water, and Steam Temperature assure efficient operation of unit #8 at West Penn Power Company's Springdale Station.

operating duties a pleasure

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A133-2

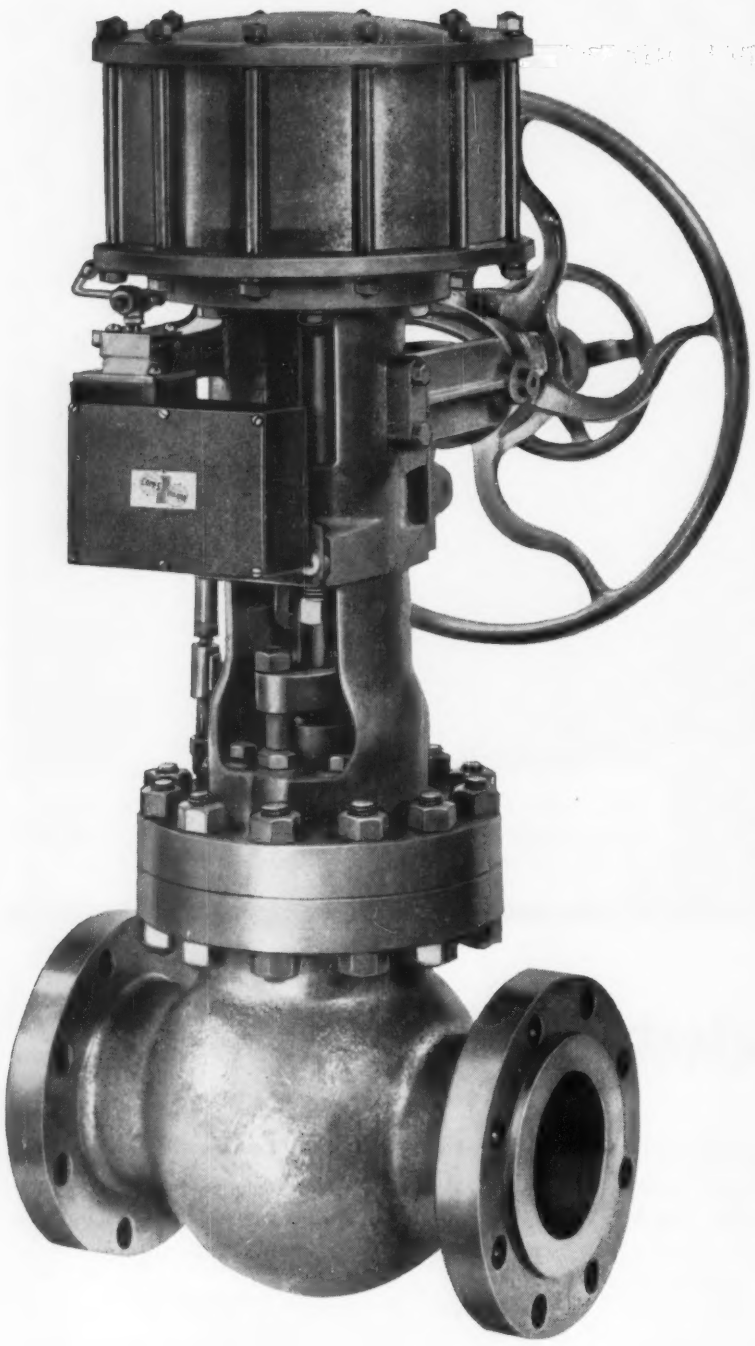
BAILEY METERS

Instruments and controls for power and process

BAILEY METER COMPANY

10 36 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

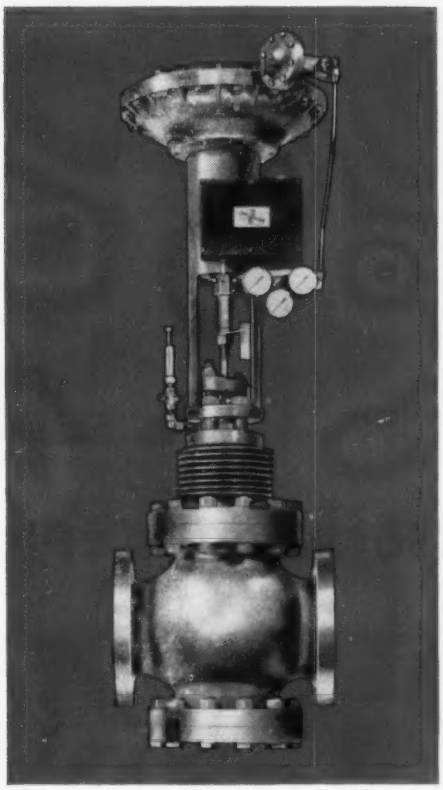


NOW

Piston-Type CV-P. For high-duty service. Extremely precise positioning gives you superb operating characteristics. Rangeability is high. Response can be characterized to meet your operating requirements. Designed for those applications which demand the ultimate in valve-operating force . . . where you want the finest valve money can buy. Hand wheel is optional.

Diaphragm-Type CV-D. Either direct or reverse acting. High rangeability. Optional features include: Cooling fins and lubricator for stuffing box that will maintain low friction over longer packing life; hand wheel for emergency operation.

the right valve for more jobs!

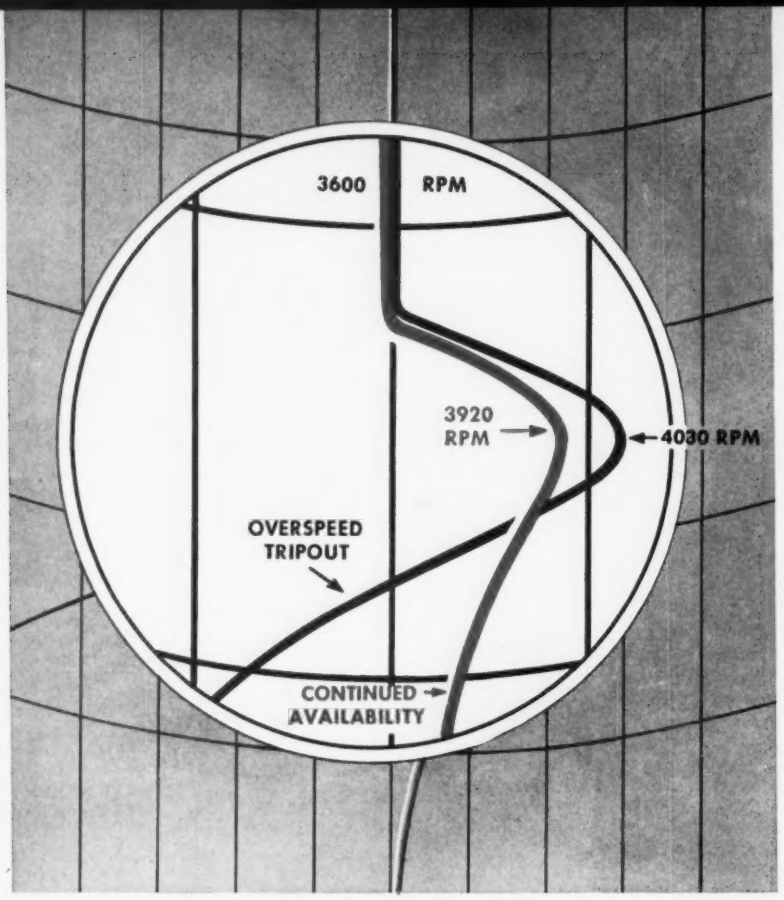


Now you can apply high-quality Copes-Vulcan Valves to any application, at unlimited pressures in sizes up to 12 inches. Simplified design gives you this new versatility, plus high standards of performance for broader applications. Too, you will get the Copes-Vulcan custom-design, with ports exactly suited to the requirements of your operation.

Get in touch with your Copes-Vulcan man. He can help you apply the new Copes-Vulcan Valves to your control requirements. You'll get real dollars-and-cents savings in operational cost with less downtime in even those troublesome spots where ordinary valves are inadequate. Write for Bulletin 1027.

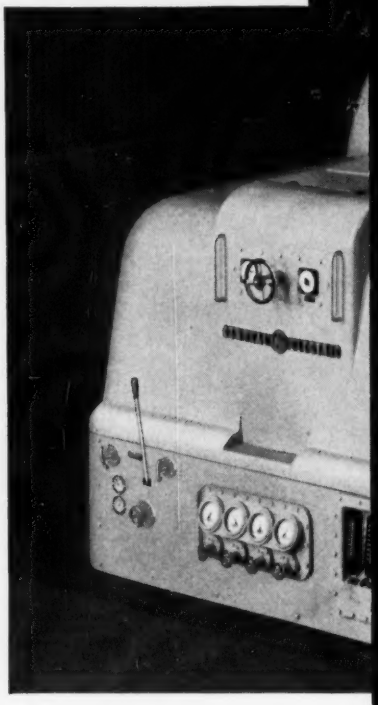
COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

50th Anniversary
BLAW-KNOX
1906-1956



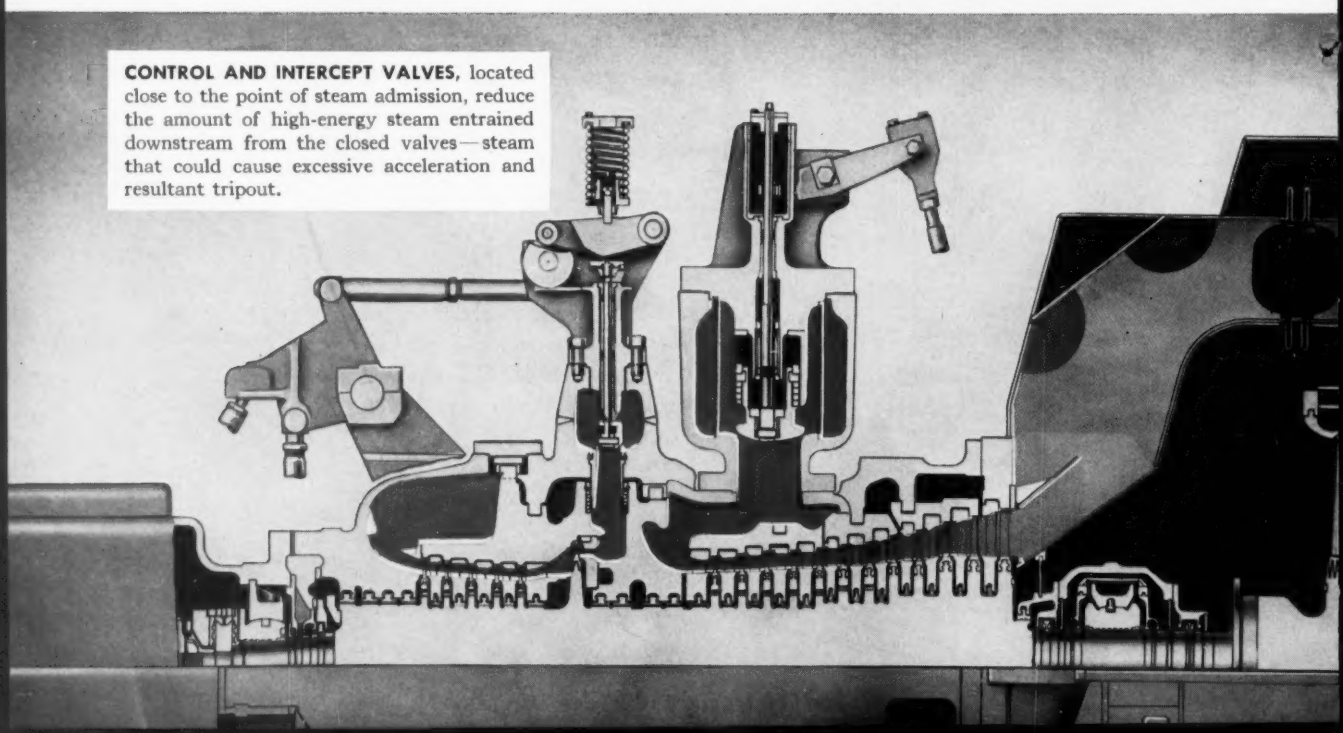
SENSITIVE GOVERNING SYSTEM helps avoid costly tripouts. The red curve, above, shows how a typical G-E reheat turbine stays below tripout speed by limiting speed to 3920 rpm during temporary system interruption. Without this split-second governing response, overspeed to 4030 rpm can result in costly shutdown.

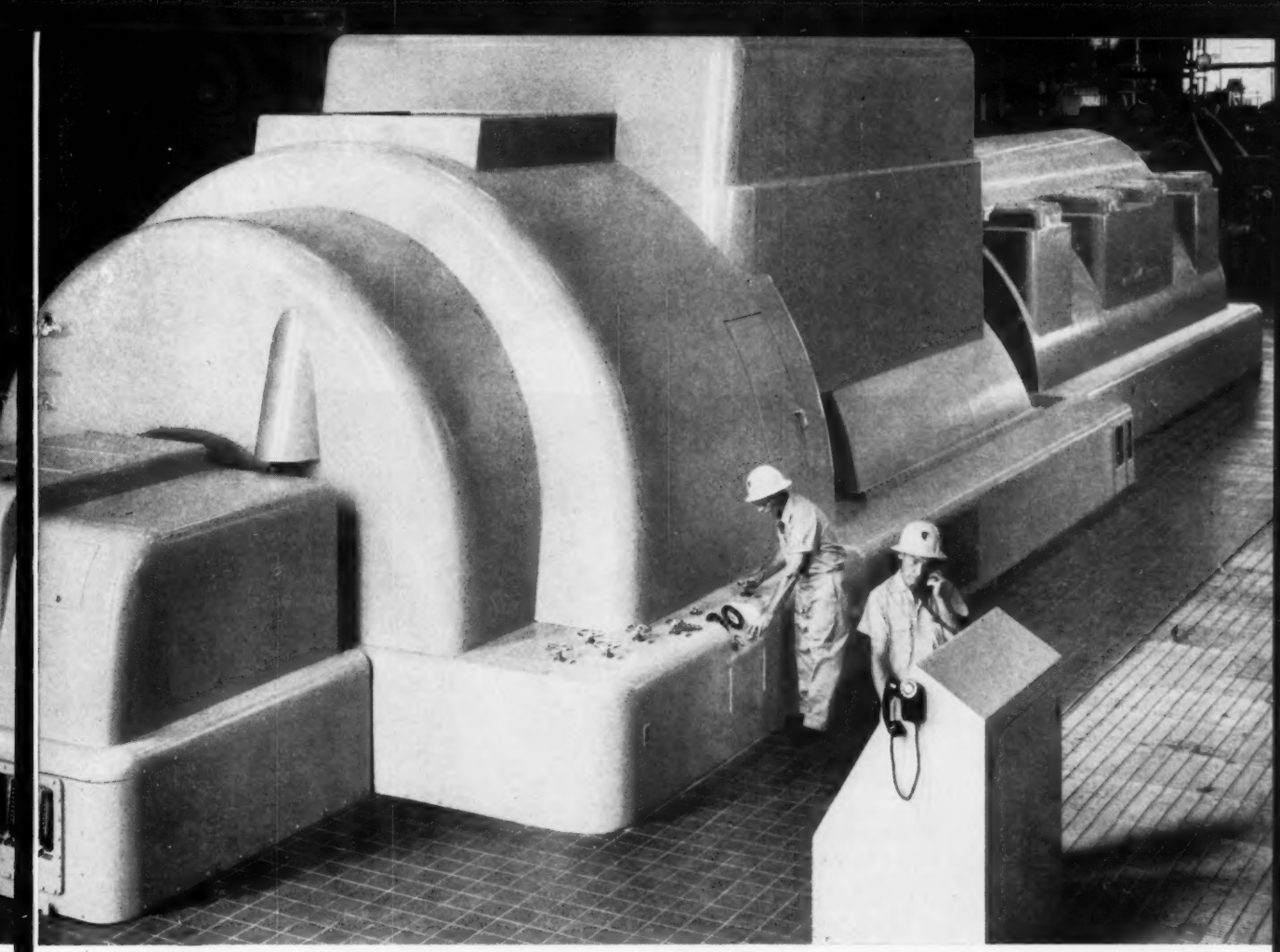
SPLIT-SECOND RESPONSE to system disturbances helps keep units like this on-the-line. Pictured here is a 150,000 kw reheat steam turbine-generator at Oklahoma Gas and Electric Company's Riverbank Station.



Split-second response helps keep

CONTROL AND INTERCEPT VALVES, located close to the point of steam admission, reduce the amount of high-energy steam entrained downstream from the closed valves—steam that could cause excessive acceleration and resultant tripout.





General Electric turbines on-the-line

SENSITIVE GOVERNING SYSTEM COPES WITH TEMPORARY SYSTEM DISTURBANCES

Requirements for sensitive, faster-responding governing systems have steadily increased with the trend toward larger reheat turbines with their inherent high overspeed potential.

Modern turbines entrain significant quantities of high-energy steam downstream from control and intercept valves and in crossover pipes. Because this steam can cause rapid acceleration upon load loss, governing systems must instantly sense speed changes to ride through temporary system disturbances. A split-second time lag may mean the difference between tripout and continued turbine availability.

Locating control and intercept valves as close as possible to the turbine operating stages reduces the amount of high-energy steam trapped downstream from the valves. With the acceleration potential of this entrained steam kept to a minimum, overspeed is limited and the turbine remains on governor control despite temporary system interruptions.

Other refinements such as use of an extremely sensitive governor and relays help make fast response possible. This governor senses the slightest change in speed and transmits a signal to activate the governing system.

Sensitive response of governing systems is another example of how General Electric turbine research and engineering leadership combine to build tomorrow's turbine-generators today. For further information on reheat turbine overspeed protection, write for bulletin GER-920, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

254-39

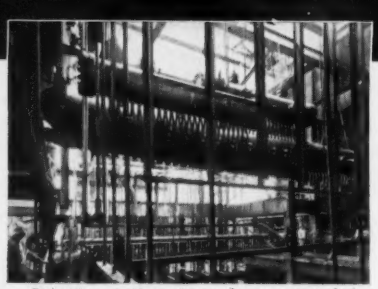
Progress Is Our Most Important Product

GENERAL ELECTRIC

Progress Report

2,000,000 lb/hr

View looking upward in the reheater section, showing the 126-ton steam drum being raised into position. Shipped completely fabricated from Foster Wheeler's Mountaintop, Pa., plant, the first of the two steam drums arrived on the job-site on May 28, 1956 and was raised into position on June 1st.



Reheater section steam drum suspended in approximate position for final location, viewed from upper level.

Reheater section showing steam drum, headers and hangers in place, looking upward from 7th floor level.

on World's First

STEAM GENERATOR

Record-shattering FW steam generator for Detroit Edison's River Rouge Plant will deliver 8,620 btu per kwhr for 320,000 kw Unit No. 3

THE first steam generator ever designed to produce 2,000,000 pounds of steam per hour is now well under construction at Detroit Edison's River Rouge Plant. This huge FW steam generator, for 320,000 kw Unit No. 3, will also be one of the most efficient and economical units ever built. With a heat rate of 8,620 btu per kwhr, it will produce a kilowatt of electricity from less than ¾ lb of coal!

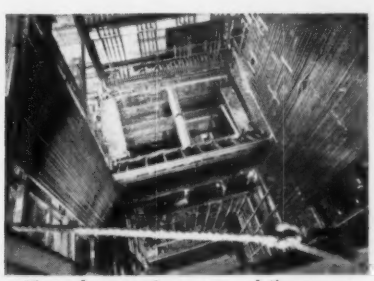
Designed for a pressure of 2700 psi, with 2450 psi and 1050F at the superheater outlet, it includes reheat facilities for resuperheating the steam to 1000F after it has passed through the initial stages of the turbine.

This single-unit FW steam generator consists of two separate sections, each containing a radiant superheater. All of the convection superheater surface is located in the "superheater section" and all of the convection reheater surface, in the "reheater section." Firing of the reheater section furnace is controlled to maintain 1000F reheat steam temperature, while the superheater section furnace is fired to maintain primary steam pressure. Primary steam temperature of 1050F is controlled by condenser-type desuperheaters.

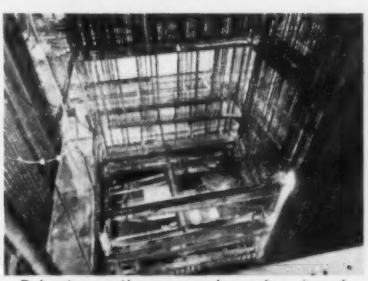
The photographs included here show progress in the erection of this history-making FW steam generator at the River Rouge plant. This outstanding installation is another example of Foster Wheeler's ability to meet the most exacting requirements of modern power plant operation. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



View of economizer space of the superheater section, looking downward from the 9th floor level.



Reheater section economizer, also viewed from 9th floor elevation during construction.

Foster Wheeler's Construction Superintendent H. A. Shouse and Field Materials Coordinator A. K. Broome inspect radiant wall tiebacks.

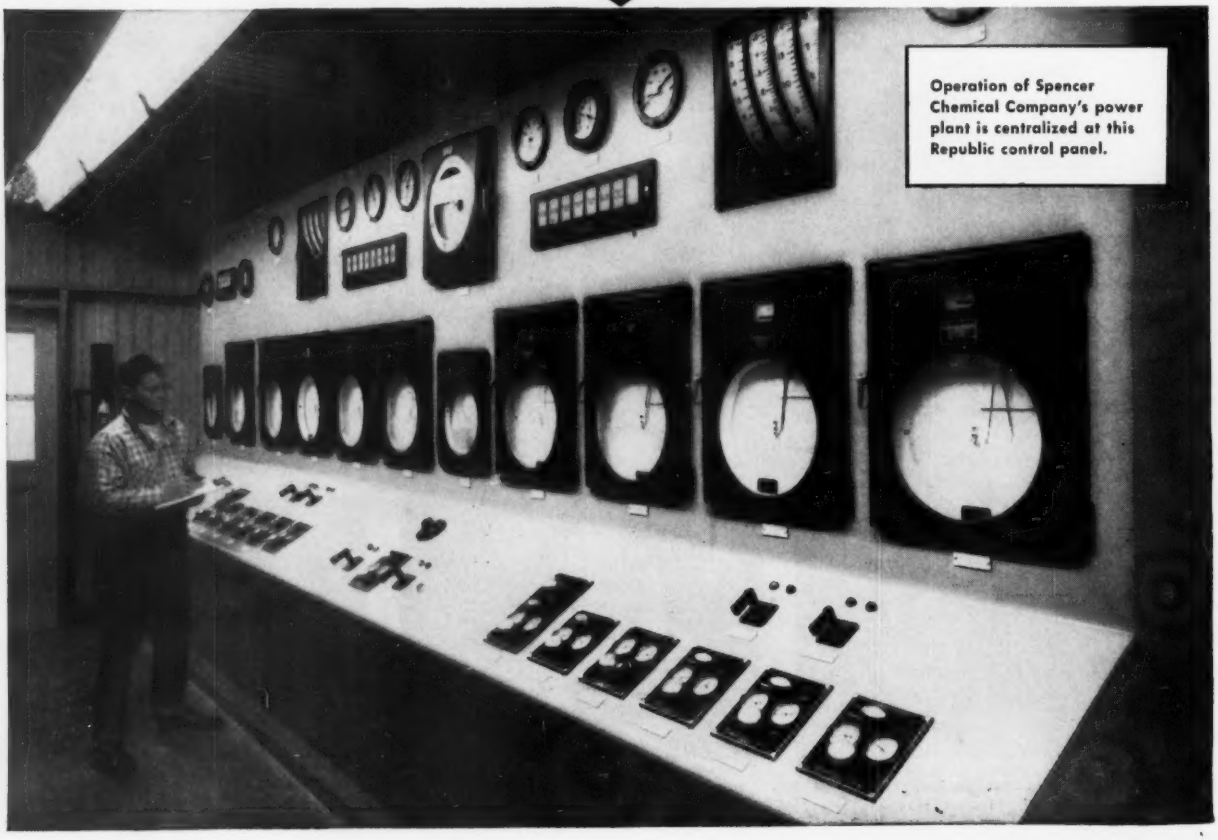
Automatically Controls Outdoor Steam Plant

FOR FAST LOAD CHANGES

REPUBLIC Combustion Control System at New Texas Chemical Plant Automatically Prevents Flame-Outs and Over-Firing on Wide Load Swings, Enables Boilers to Meet Sudden Steam Demands Smoothly and Safely

Extremely large and fast load changes make combustion efficiency only part of the combustion control job at Spencer Chemical Company's new Orange Texas polyethylene plant. The control system operates two gas fired 60,000 lbs. per hour boilers in the plant for fast response to load changes without over-firing or losing ignition on wide load swings.

To prevent over-firing when there is a sudden demand for more steam, a gas



Operation of Spencer Chemical Company's power plant is centralized at this Republic control panel.

safety regulator keeps the fuel valve in step as draft fans increase speed. By compensating for the unequal speed of response of the two boiler auxiliaries, the control system maintains proper conditions *even while loads are changing.* If steam demand falls below minimum steam conditions, a minimum gas pressure is maintained automatically at the burners, regardless of the number in service, to prevent flame-outs. In addition to safer operation, these features also mean continuous combustion efficiency for extra fuel savings.

When your problem is combustion control—for a small power plant or a central station—it will pay you to contact Republic. At your service is an experienced engineering staff that can design the control system that exactly meets your needs—specialized as they may be. This combination of expert design and modern Republic equipment can assure you of dependable, efficient control of your power plant.

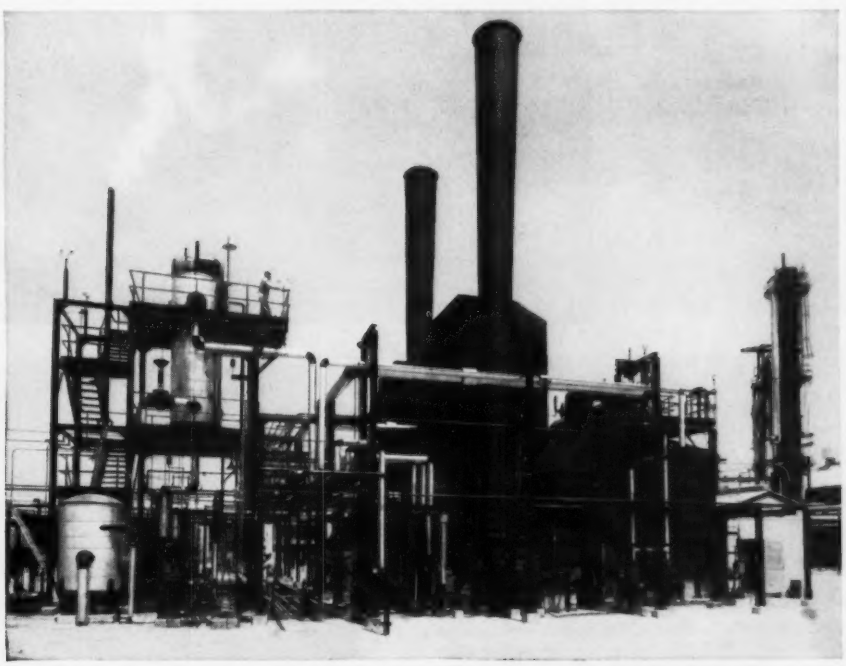
REPUBLIC

Automatic COMBUSTION CONTROLS

(pneumatic or electronic)

- ★ **FOR ALL SIZES AND TYPES OF BOILERS**
- ★ **FOR ALL LOAD CONDITIONS**
- ★ **FOR ALL METHODS OF FUEL FIRING**
- ★ **FOR ANY ARRANGEMENT OF DRAFT**

Write for details



THE ENTIRE POWER PLANT,

except for the control panel is outdoors. Panel board is housed in sheet metal building at right. The two 60,000 lbs. per hour gas fired boilers, operating at 415 psi and 750°F., furnish steam to compressors used in converting ethylene gas into polyethylene. This is new miracle plastic that is used for products ranging from "squeeze" bottles to electrical insulation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

SEVEN WONDERS OF THE

. . . developed with the help of the World's Greatest Lubrication Knowledge!

A giant wind tunnel that "flies" jets at supersonic speeds . . . a submarine that runs on nuclear power . . . a machine that makes genuine diamonds. These are some of the scientific wonders pictured on these pages. Each one is *the first of its kind*—designed to add to man's knowledge of the world around him. And each was developed with the help of Socony Mobil's vast lubrication knowledge.

When new machines are being planned . . . when unknown problems of lubrication lie ahead —machine builders and machine operators have found it pays to call on Socony Mobil.

Whatever *your* lubrication problems, large or small, we're ready to help you solve them . . . to improve your production, reduce costs through a program of *Correct Lubrication.*

SOCONY MOBIL

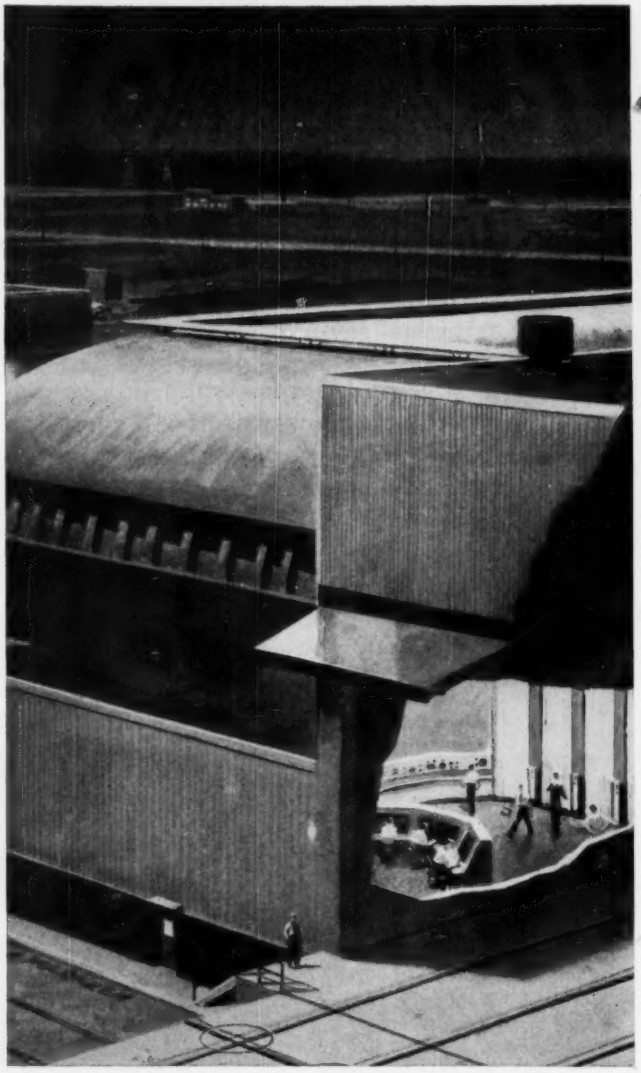
Mobil

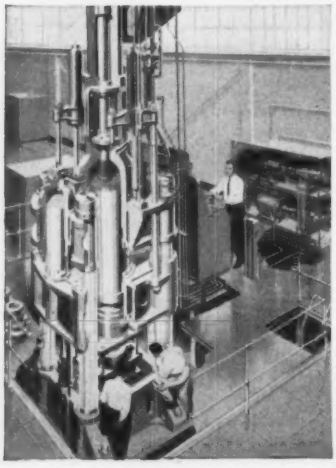
Correct Lubrication

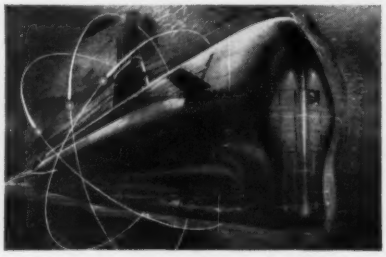
FIRST STEP IN CUTTING COSTS

Leader in Lubrication for 91 Years

SOCONY MOBIL OIL COMPANY, INC., and Affiliates:
MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION, MOBIL OVERSEAS OIL COMPANY, INC.

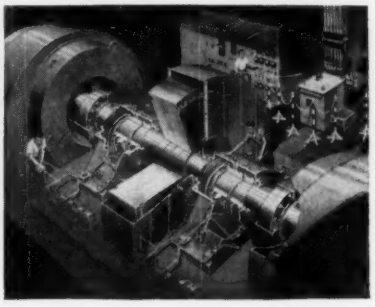






World's first atomic-powered submarine —U.S.S. Nautilus travels on power generated by fissionable material.

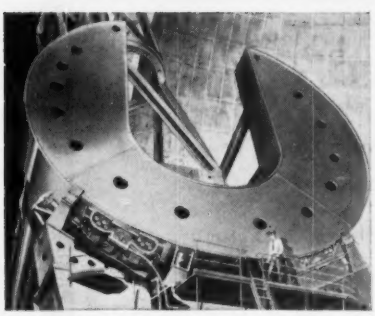
World's only diamond-making machine —develops up to 1,500,000 lbs. pressure and 5000°F. temperatures to create genuine diamonds.



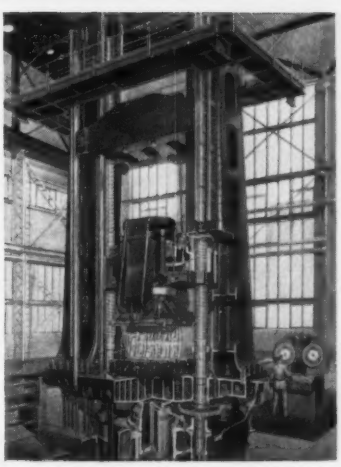
Giant atomic accelerator—the Cosmotron at Brookhaven National Laboratory is powered by a Mobil lubricated Westinghouse Motor Generator.

SCIENTIFIC WORLD

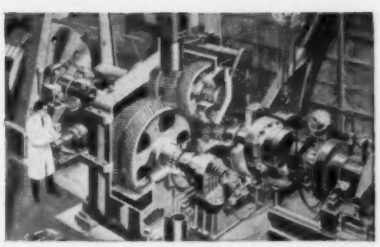
World's most powerful wind tunnel—largest of its type, at the U. S. Air Force's Arnold Engineering Development Center, is powered by motor-driven compressor system that is largest rotating mass ever built. Typical tests will involve new fighters equipped with modern jet engines like the Pratt & Whitney J-57 shown here.



World's largest telescope at Mount Palomar Observatory has 200" lens, weighs 500 tons. It floats on microscopic film of Mobil D.T.E. Oil.

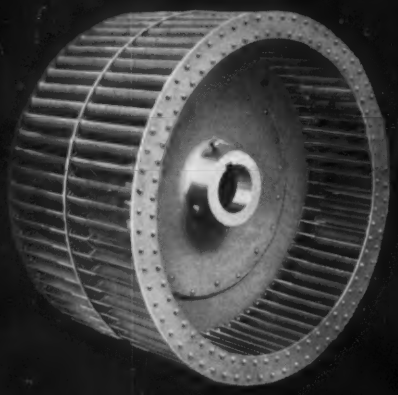


World's largest testing machine can apply a tensile or compressive force of up to 5,000,000 lbs. to test full-scale sections or complete units of every type.



World's largest dynamometer tests brake materials under varying pressures, speeds and temperatures. 200-ton machine is 100% Mobil protected.

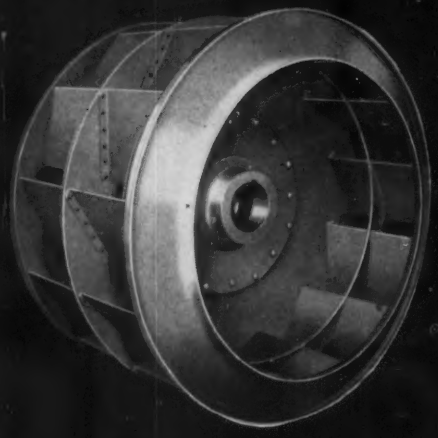
American Blower Fan Wheels



SIROCCO WHEELS

for forced and induced draft duty

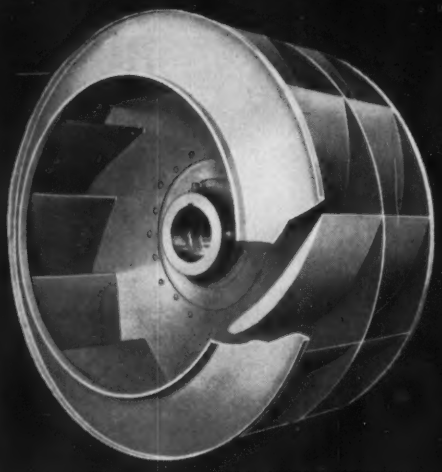
- For balanced draft or pressurized furnace
- Low tip speed
- Die-formed, forwardly inclined blades and heavy streamline inlets
- Used in power plants the world over



AHS WHEELS

for forced and induced draft duty

- Backwardly inclined, nonoverloading horsepower characteristic
- For given duty operates at higher R.P.M.
- Single thickness flat or curved blade
- Heavy rolled streamline inlets

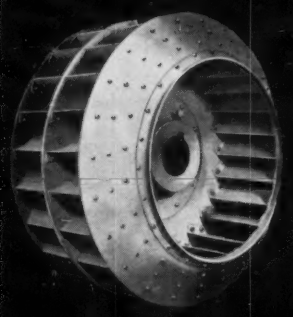


AIRFOIL BLADE WHEELS

primarily for forced draft duty

- Blades are of airfoil cross section, die formed and reinforced as required
- High mechanical and static efficiency
- Nonoverloading power characteristic
- Available with vanes and/or boxes

Meet Peak Efficiency Standards



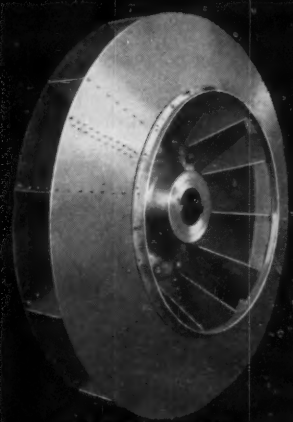
Radial tip blade wheel

RADIAL BLADE WHEELS

for forced, induced and gas recirculating duties

- Pressure characteristic favorable to gas recirculating application where unusual system pressures prevail
- Designed for severe temperature and pressure duty
- Available with straight radial or radial tip blades

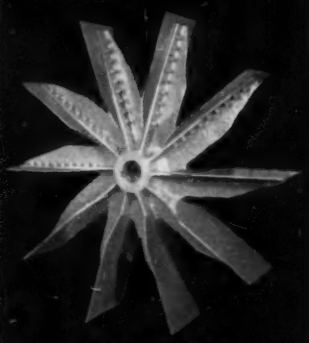
Straight radial blade wheel



Rim type wheel for primary air fans

SINGLE INLET RADIAL BLADE WHEELS FOR PRIMARY AIR, VENT, AND OVER FIRE DUTY

- Designed for high temperature, high pressure applications
- Radial or backwardly inclined blades, single inlet
- Over 1200 primary air fans in operation



Rimless wheel for vent and over fire fans

IF YOUR plans include mechanical-draft equipment—for new installations or as replacements—consult your American Blower sales engineer. He can give you helpful information on job-fitted American Blower equipment to meet your power-plant requirements. Call our nearest branch office or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ont.

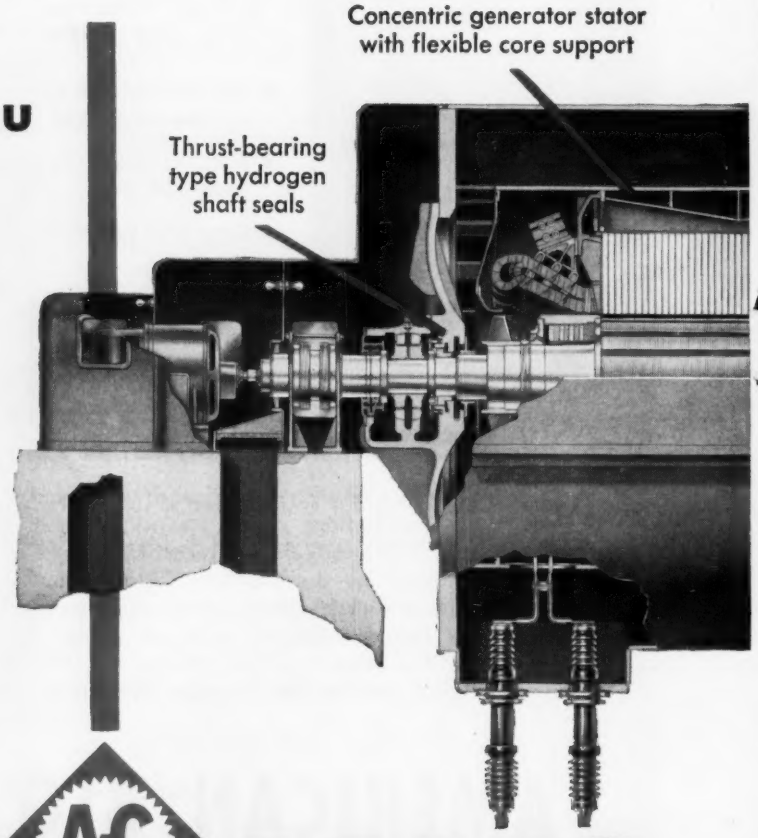
AMERICAN BLOWER

Division of AMERICAN-Standard

Now in Ratings

Here is the turbine rotor for one of the 16,500-kw units now being built. For this 850-psig, 900-F AIEE-ASME turbine, rotor shaft and wheels are of integrally forged construction.

Allis-Chalmers Turbines Give You MORE Modern Design Features



CUTAWAY VIEW of 16,500-kw unit shows the development of impulse turbine design for larger ratings.

A-C ALLIS-CHALMERS

ALLIS-

Production up to 16,500 Kw

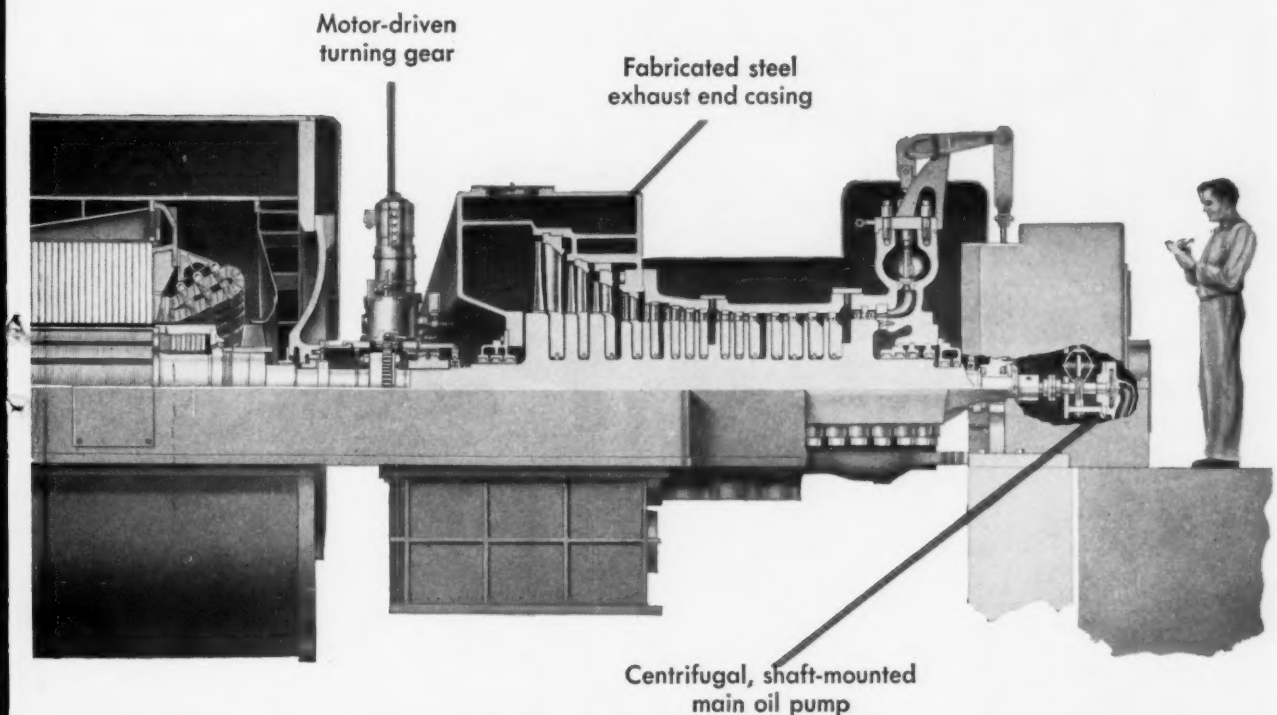
NEW Large WA-Series Turbines Offer

Advanced ● Design Features **Simplified ● Installation** **AIEE-ASME ● and NEMA Ratings**

NEW WA-Series steam turbine-generator units now being manufactured include the 10,000-kw NEMA standard rating as well as 12,650-kw and 16,500-kw AIEE-ASME preferred standard condensing ratings. The 16,500-kw units have hydrogen-cooled generators.

Incorporated in the design are time-proved labyrinth steam sealing, removable external glands, high chrome alloy steel buckets and nozzles, reliable governing system, and unit shipment and installation — plus additional large turbine and generator features.

To get MORE information on economical, dependable units 2000 kw and larger, call the nearest A-C district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.



CHALMERS

LIVE BETTER ELECTRICALLY

A-5127

New! Multi-purpose

Gulfcrown stands up to cold. It pumps easily in coldest weather at temperatures of 0°F. and below.

GULFCROWN Grease

does the work of many greases —withstands heat, cold, water

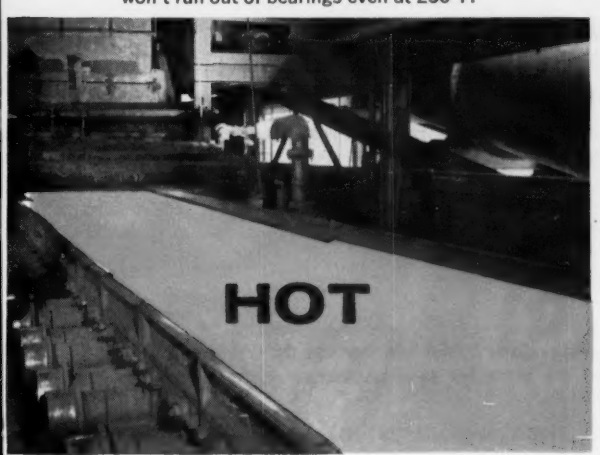
It's a fact—you can use Gulfcrown practically anywhere! On plain or antifriction bearings. In paper mills, textile mills, steel mills, power plants. Outside or inside. You name it, chances are Gulfcrown will lubricate it—but good! Operating conditions can be hot, cold or wet . . . this tough all-purpose grease does its job regardless.

You can see how one multi-purpose grease that does the work of many is a big money-saver. It reduces inventory, cuts lubricating costs and prevents application errors. Check the saving yourself—test Gulfcrown. Ask your Gulf sales engineer or write for free literature.

GULF

GULF OIL CORPORATION
1822 Gulf Building, Pittsburgh 30, Pa.

Gulfcrown resists heat. It won't get thin, won't run out of bearings even at 250°F.



Gulfcrown sheds water—won't wash away. That's why it's a good rust preventive, too, under the dampest conditions such as this wet end of a paper machine.

An answer for every electric utility

A PLANNED OUTAGE IS NO OUTAGE

Five hundred kw is not a large unit of power by utility standards. Not, that is, unless it is badly needed . . . and not available.

That's why more and more utilities are finding an increasing number of uses for the Electro-Mobile 500 kw highway-trailer generating unit. It can go anywhere, pick up a load in minutes, permit construction or maintenance crews to work without interrupting service to customers.

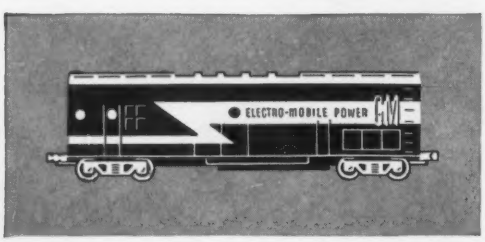
In addition, Electro-Mobile Power offers an immediate source of emergency power to areas that might otherwise be without service for a long period of time. Used in multiple, there is no limit to the amount of power these units can supply.

The savings from Electro-Mobile Power are many. Rebuilding or maintenance work of any duration can be handled during regular working hours. Work goes faster, in greater safety, and most important—customer relations and income are maintained during the temporary outage.

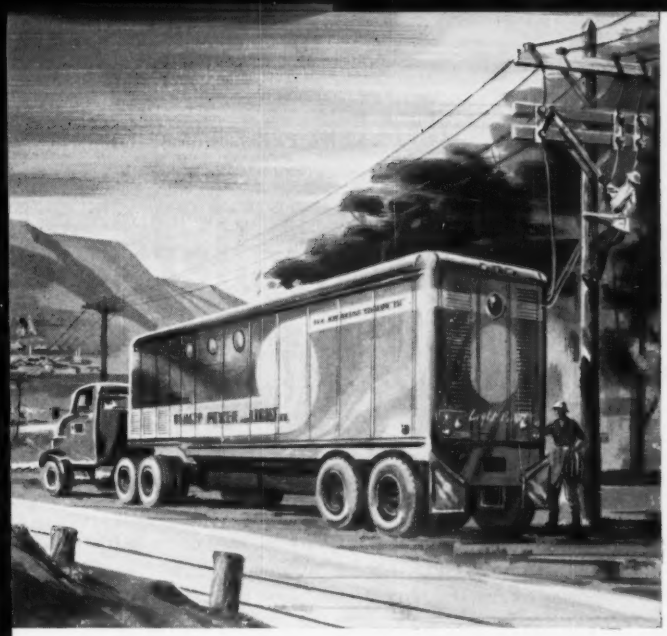
A planned outage is no outage with Electro-Mobile Power. Its many advantages are helping to reduce costs and improve service for many utilities. It can do the same for your system. Your Electro-Motive representative will be glad to show you how.

Here's how one Midwestern utility company uses its Electro-Mobile trailer...

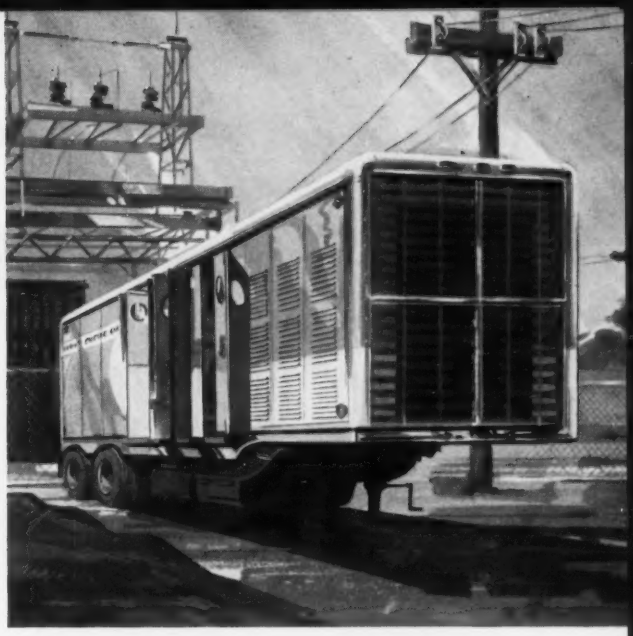
In a span of twelve months, this utility used its Electro-Mobile trailer on fifteen different jobs. Shown here are some examples of the work completed and in progress with this unit. During the year the mobile trailer was operated over 340 hours. On one job alone, it was used 145 hours, delivering 58,500 KWH.



Rail Car—develops 1,000 kw. For use on rail sidings or placed on piers for semi-permanent installation.

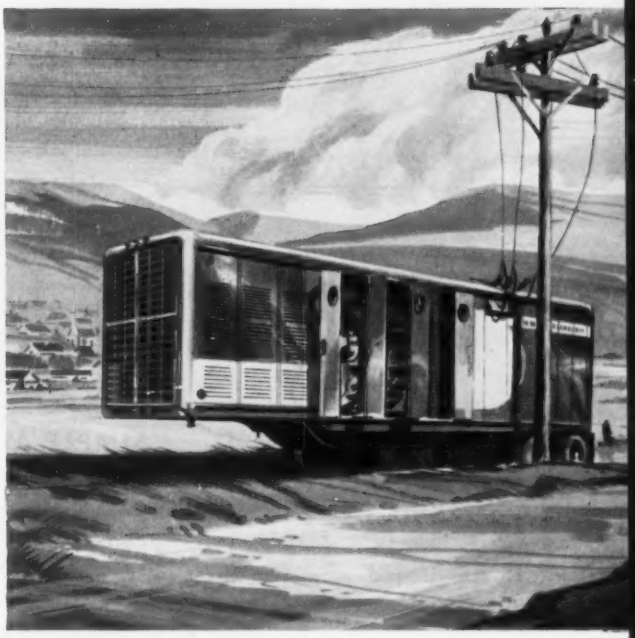


Relocating 12,400-volt line for new highway.
Hours used: 68 ¼ KWH generated: 22,700



Installation of new transformer for substation.
Hours used: 3 ½ KWH generated: 1,100

Feeding 12,400-volt sub-transmission line while stringing new conductors on transmission line.
Hours used: 145 KWH generated: 58,500



Handling daily peaks while existing transmission line and substation are being rebuilt.
Hours used: daily average 4

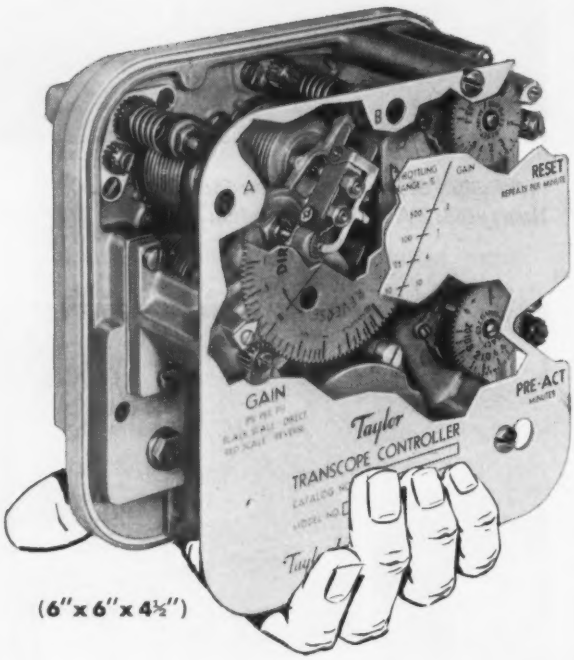
ELECTRO-MOTIVE DIVISION
GENERAL MOTORS
LA GRANGE, ILLINOIS

Sales Offices in Chicago, New York, St. Louis, San Francisco

NEW IN PRINCIPLE . . . NEW IN DESIGN . . . NO EQUAL IN PERFORMANCE!

New Taylor TRANSCOPE* Controller

The last word in Pneumatic Control



(6"x6"x4½")

SUPERIOR PERFORMANCE

1. Especially suited for short spans of measurement . . . ideal for time constants of modern control . . . outstanding in insensitivity to ambient temperatures.

2. Exceptionally fast and responsive to adjustments —vital on start-ups.

3. Accurate, pre-determined mathematical settings made possible by precision manufacture of gain, reset and PRE-ACT* units. Adjustments stay put.

EXCEPTIONAL ADAPTABILITY

1. Adaptable to changes in process requirements . . . complete interchangeability of components so you can convert from simplest to most complex forms of control *in the field* . . . in minutes.

2. Instrument action reversed by merely rotating a dial. Plugs into TRANSET* Indicators and Recorders or locally mounted manifolds.

3. Designed to meet the demand for more compact instruments, it is ideally suited for use in graphic panels and scanning and logging systems.

SIMPLE MAINTENANCE

1. Rugged bellows assembly, keyed in place, moves the dynamically balanced force plate . . . friction-free bending member never needs maintenance.

2. Husky die-cast aluminum assemblies, accessible stainless steel nozzle and baffle, hardened stainless steel reaction members. Dust and moisture-proof case.

3. Ease of alignment—smooth-acting, screw-driver adjustment because of ball bearing construction.

4. Easy to understand . . . easy to get at . . . simplifies maintenance training.

5. Integral cut-off relay is a built-in feature.

*Trade-Mark

The **Transcope Controller** is so compact, so simple, so smooth and responsive to adjustments yet so accessible for every purpose that it really "gets" you. But the "pay-off" doesn't come until you put it on your toughest job. Only then can you realize how contagious enthusiasm can become.

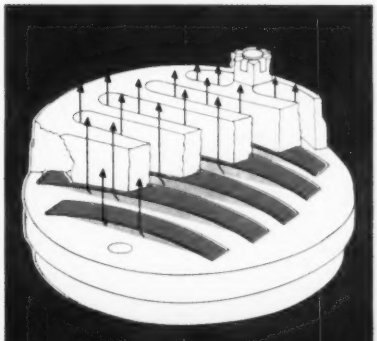
▼ ▼ ▼

Write for **Bulletin 98278.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

Taylor Instruments
MEAN
ACCURACY FIRST
VISION · INGENUITY · DEPENDABILITY

Just a puff of air lifts the valve strip...

WORLD'S "FASTEST" COMPRESSOR VALVE!



Stainless steel strips, in red, open the Feather Valve ports by rolling contact against the lower plate. There is no impact.

It's not magic, merely a demonstration of Worthington's amazing Feather* Valve —the lightest, fastest-acting compressor valve on the market. Less than half a pound of air pressure will operate the valve in a standard two-stage 100 psi Worthington machine.

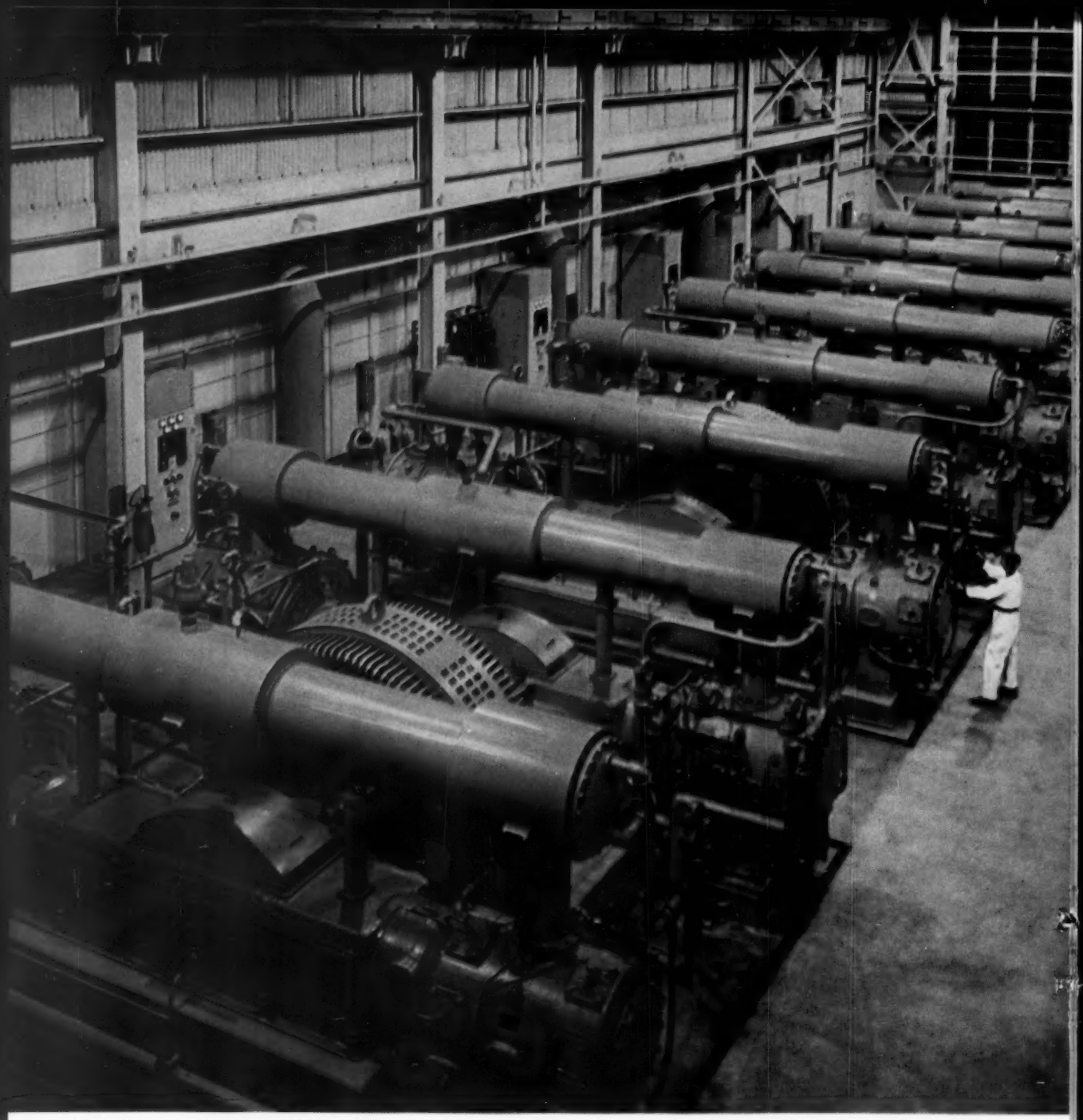
Because of its lightness and flexibility, Feather Valve action is very sharp. There is virtually no slip or back flow. Result: real savings in power costs.

No Impact. Even when operating as fast as forty times a second, the Feather Valve works with no impact. Lack of impact plus the absence of buffer plates and cushioning accessories assure long life and negligible valve maintenance.

For an on-the-spot report of a Worthington "Feather Valve" water-cooled compressor in action, see the next page.

WORTHINGTON

*Reg. U. S. Pat. Off.



Worthington Feather Valve air compressors operating at the Ford Motor Co. Plant, Cleveland, Ohio.*

HOW TO GET THE PLANT AIR COMPRESSOR YOU NEED

As in the above Ford plant, compressed air is a basic power service in most every modern industrial plant. Equipment reliability and long life are a must.

Worthington makes a complete line of water-cooled air compressors. Every machine is available in a standard unit, from the single horizontal "midgets" to the big balanced opposed "giants." This standardization allows complete freedom of choice and you can install these high quality machines at lowest possible cost in a surprisingly short time.

For more information about your compressed air needs, write Section K-71, Worthington Corporation, Harrison, New Jersey. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ont.

WORTHINGTON

See preceding page

ONE OF THE GARLOCK 2,000

Wet and Dry Tests Prove...

GARLOCK 662 GASKET MATERIAL
does not shrink or change shape

Here's convincing proof that gaskets of Garlock 662 can stand varying climatic conditions without drying, shrinking, or hardening. The gaskets illustrated were subjected to a 24-hour alternating wet and dry test for weeks, then conditioned at room temperature. As the photo and chart at right show, 662 gaskets returned to their original shape and to within 1% of their original thickness. Competitive types hardened, twisted, and shrank as much as 8%. No wonder so many companies are specifying 662 for use against gasoline, water, and oil at temperatures up to 300°F. It is approved by Underwriters' Laboratories, Inc., for use against hazardous liquids.

And longer-lasting 662 Gasket material is only one of "the Garlock 2,000" . . . two thousand styles of gaskets, packings, and seals to meet all your needs. It's the only complete line. It's one reason you get unbiased recommendations from your Garlock representative.

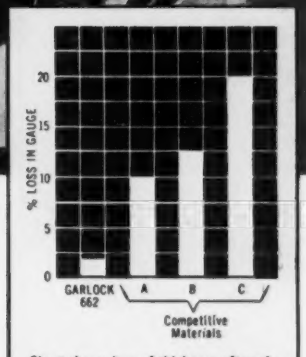


Chart shows loss of thickness after alternating wet and dry exposure tests. Garlock 662 returns to within 1% of original thickness. You can make these tests yourself. You'll prove that No. 662, made from a cork paper base impregnated with a synthetic rubber, is dimensionally more stable than competitive products.

THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, *contact one of our 30 Sales Offices and Warehouses throughout the United States and Canada.*

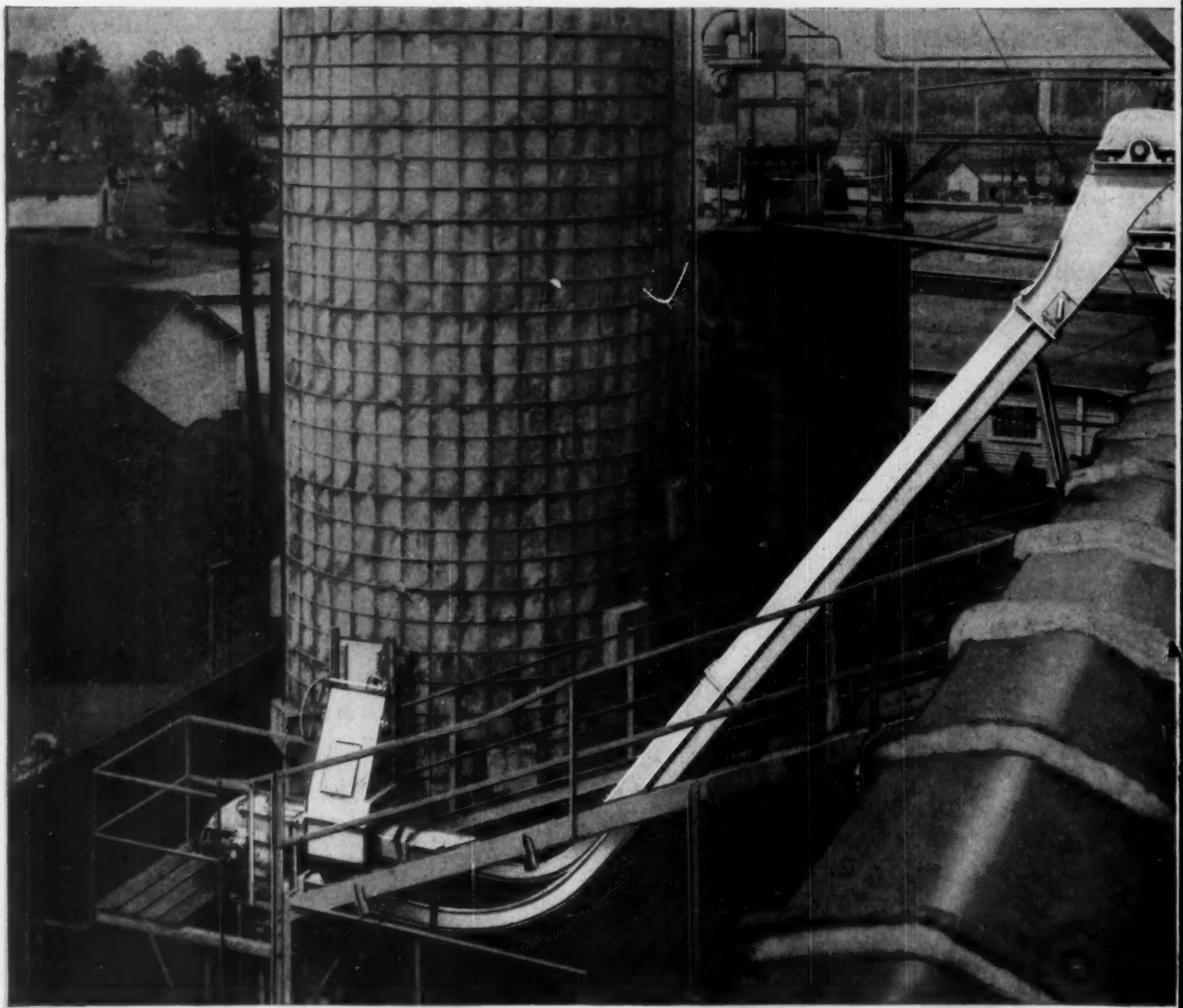
Write for this folder AD-159 which completely describes how these Wet and Dry Tests were made . . . it also contains actual samples of 662 Gasket material before and after testing.

GARLOCK

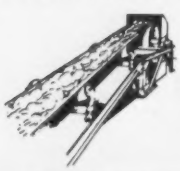
Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

STEPHENS-

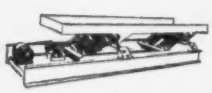
King coal will



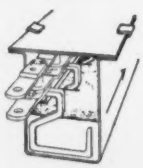
S-A MANUFACTURES A COMPLETE LINE OF PRODUCTS DESIGNED TO



BELT CONVEYORS

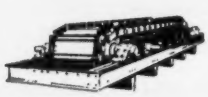


VIBRATING CONVEYORS



REDLER CONVEYORS, ELEVATORS

ZIPPER CONVEYOR-ELEVATORS



PAN CONVEYORS

BUCKET ELEVATORS

BIN GATES—ALL KINDS

-ADAMSON

take some handling for years to come

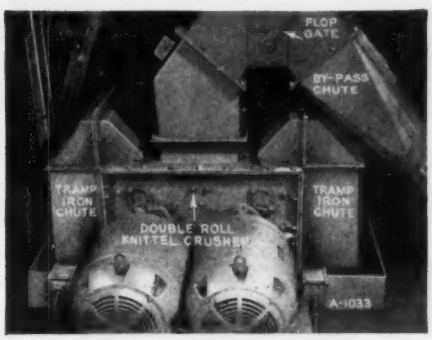
A southern bleachery utilizes this STEPHENS-ADAMSON REDLER handling system to deliver coal from silo storage to bunker. Sealed REDLER construction permits open air operation without dust.

Energy from atoms is still in the future. Coal will reign for some time as king fuel for steam power generation. So long as coal retains this importance, handling techniques will continue to be a major concern for the power engineer.

In providing the ways to keep coal handling costs where they belong, STEPHENS-ADAMSON has, over many years, developed a complete and effective line of conveying equipment. S-A engineers use these products strategically in devising the best system for coal distribution in or outside of the power plant.

To the plant operator, an S-A conveying system means continuous, uninterrupted coal flow with minimum supervision, maintenance, or replacement. Its his ally for economical operation.

The STEPHENS-ADAMSON engineer in your district will provide a free survey of your coal handling requirements.



STEPHENS-ADAMSON builds a variety of crusher equipment. This double rotor Knittel crusher handles damp, sticky coal without plugging, reducing large lumps to 1½" to ¼" size. Furnished with or without tramp iron release fingers for removal of uncrushable materials.

Amalgamated Sugar Co., Nyssa, Oregon, moves coal to combustion with an S-A system which includes this double leg 23' REDLER conveyor. The REDLER receives coal from a long belt conveyor. In the first seasons' operation, this system delivered almost 44,000 tons of coal in 149 days.

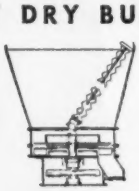
DESIGNERS • ENGINEERS • FABRICATORS

STEPHENS-ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIFORNIA
BELLEVILLE, ONTARIO

HANDLE ANY DRY BULK MATERIALS

VIBRATING SCREENS



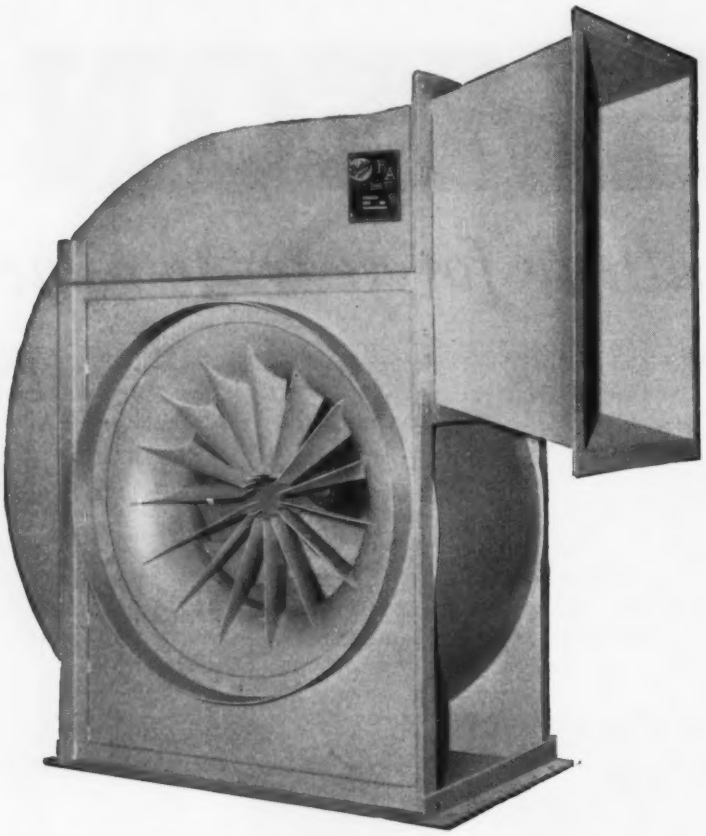
CIRCULAR BIN DISCHARGERS

SEALMASTER BALL BEARING UNITS

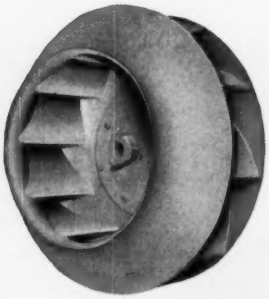
S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

- Belt Conveyors
- Belt, Pan & Plate Feeders
- Ship Loading Boom Conveyors
- Stacking Conveyors
- Storage & Reclaiming Systems
- "Natural Frequency" Vibrating Conveyors
- REDLER Conveyor-Elevators
- ZIPPER Conveyor-Elevators
- Conveyor Belt Cleaners
- Headshaft Holdbacks
- Grizzlies & Screens
- Centrifugal Pilers
- Bin Gates & Tunnel Gates
- Car Pullers & Spotters
- Bucket Elevators
- Skip Hoists
- SEALMASTER Ball Bearing Units

• *Write for a bulletin on any of the above products.*



TYPE "BA" WHEEL



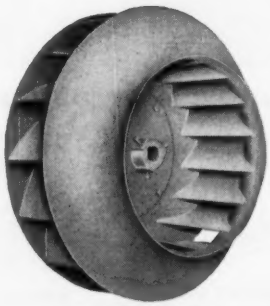
TYPE "CA" WHEEL

TYPE "AA" WHEEL

NOW—PICK THE FORCED

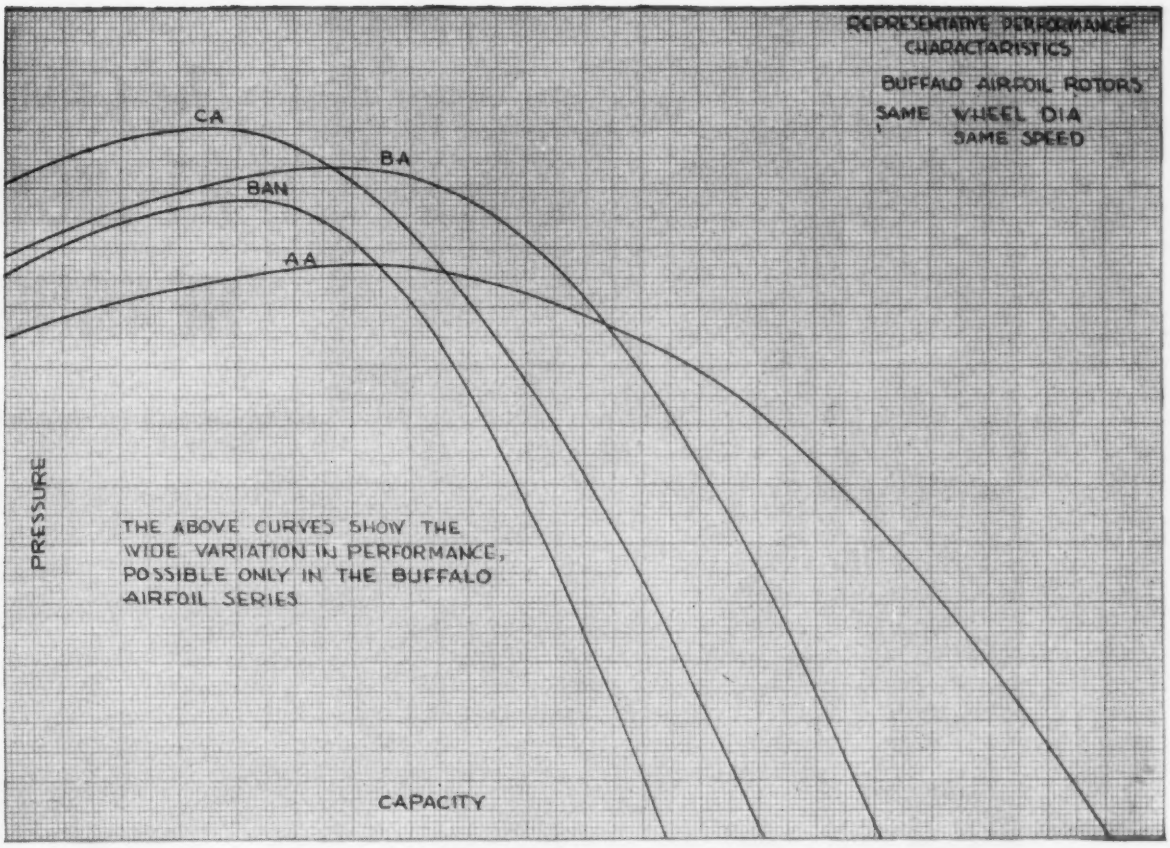
4 SERIES OF "BUFFALO" AIRFOIL

1. "BA", the basic wheel of the line — for many general forced draft and industrial requirements. Note broad air channels provided by extra-wide blades.
2. "CA", a wheel for higher pressures and lower capacities.
3. "AA", for lower pressures and higher capacities.
4. SEMI-AIRFOIL WHEELS like the "CLM", with airfoil noses and single thickness backward curved blades, closely approach performance of full airfoil wheels. This wheel has a definite application where a single thickness is advantageous.



TYPE "CLM" WHEEL

ALL WHEELS VARIABLE AS TO WIDTH, TO GIVE YOU PEAK EFFICIENCY FOR *YOUR* OPERATING CONDITIONS



ONLY "BUFFALO" BRINGS YOU THIS BROAD SELECTION—PLUS EFFICIENCIES UP TO 92%

DRAFT PERFORMANCE YOU WANT

FANS TO MATCH YOUR CONDITIONS EXACTLY

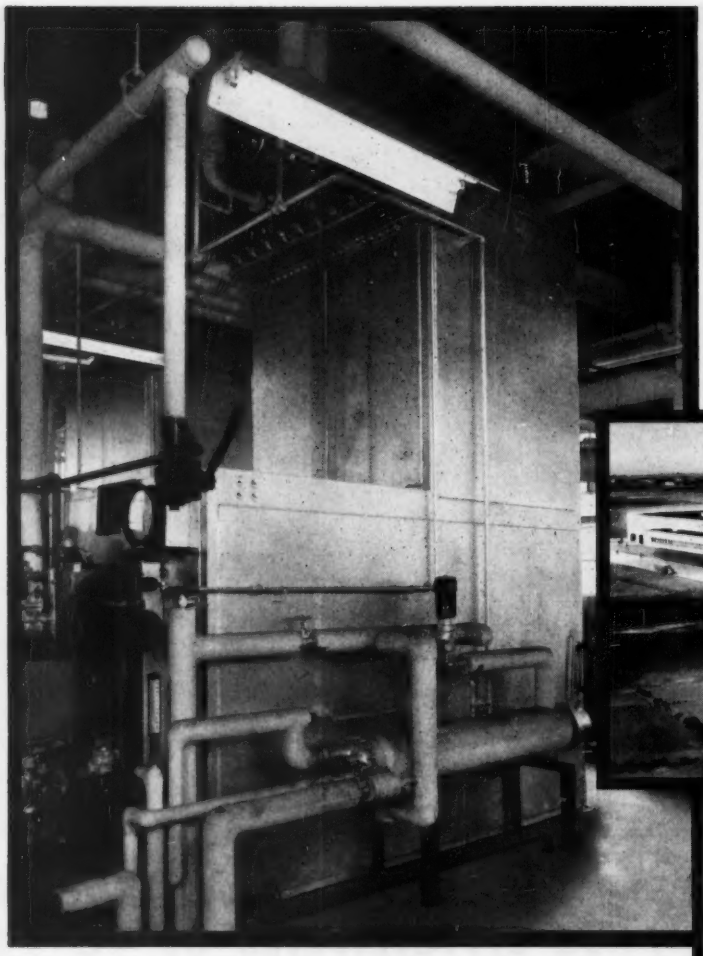
Not just an airfoil fan, but *four complete series* — six types of interchangeable airfoil and semi-airfoil wheels in varying widths — to give you maximum efficiency for your operating conditions! "Buffalo" deep-blade airfoil design offers a new high in forced draft efficiency — not just on paper, but in actual operation. In addition to the effective, high-strength airfoil and semi-airfoil blades, these "Buffalo" Fans go beyond the usual concept of streamlining. From the smoothly rounded inlet to the divergent outlet, all sources of turbulence has been eliminated. If you wish the highest possible efficiency in a forced draft fan tailor-made for your particular operation, by all means, write for Bulletin FD106 and our engineering recommendations.

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

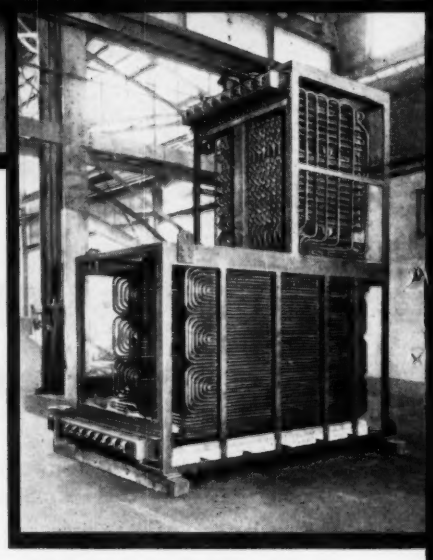
"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

The Cross HIGH HEATING



C-E HT Boilers in service at the Cross Company. They are fired by oil or natural gas.



One of the two Cross Company boilers being assembled in the C-E shops.

THESE ARE THE GENERAL ADVANTAGES OF HIGH TEMPERATURE WATER:

1. Higher available heat — many times that of steam at the same pressure.
2. Closer control of temperature.
3. Lower heat loss . . . unused heat returns to the boiler . . . no condensate return lines.
4. No elaborate feedwater treatment . . . make-up requirements are exceptionally low.
5. Steam traps not required . . . trap problems and expense are eliminated.
6. No blowdown losses . . . no safety valve vent losses . . . no condensate losses.

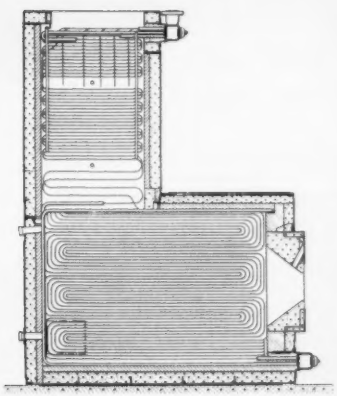
THESE ARE THE SPECIFIC ADVANTAGES OF THE C-E "HT" WATER BOILER:

1. Complete control over circulation in both system and boiler.
2. No separate boiler pump is required, since low pressure loss is inherent.
3. Pressurized operation with oil or gas means no induced draft fan.
4. Single-pass design—no baffles—means cleaner boiler and lower draft loss.
5. Controlled, positive circulation permits more efficient arrangement of heating surfaces.
6. Any fuel—oil, gas, coal, or any combination of fuels.
7. Gastight, welded steel casing.
8. Fewer headers, all of which are easily accessible.

Company specifies–

TEMPERATURE WATER BY C-E FOR ECONOMY...LOW MAINTENANCE

Architect's drawing of the new Cross Company plant, Giffels and Vallet, Detroit, Consulting Engineers; Owen S. Lieberg, Associated Consultant.



Combustion HT Water Boilers are available in sizes from 10- to 300-million Btu per hour. Drawing shows one of the 12-million Btu/hr. Cross Company boilers.

The Cross Company, pioneer producer of automation machinery, has recently completed an ultra-modern plant in Fraser, Michigan – practically doubling its former production capacity. After a thorough study of heating requirements . . . and with a view toward further expansion . . . two C-E LaMont Controlled Circulation Hot Water Boilers were specified for the new plant. According to Mr. W. P. Reece, Plant Engineer, "the study indicated that this system would provide the lowest fuel and maintenance costs . . . Experience during this winter confirms the soundness of our decision."

The C-E LaMont Controlled Circulation Hot Water Boiler is available in sizes ranging from 10- to 300-million Btu per hour, with pressures up to 500 psi and temperatures to 470°F – or higher if required.

If you are in the market for a heating or process system, it will pay you, too, to investigate high temperature water. Individual needs vary, of course, and both hot water and steam boilers have their place. Our engineers will be pleased to discuss the subject with you or your consultants. Write for our catalog HCC-2.

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.
CANADA: COMBUSTION ENGINEERING-SUPERHEATER LTD.

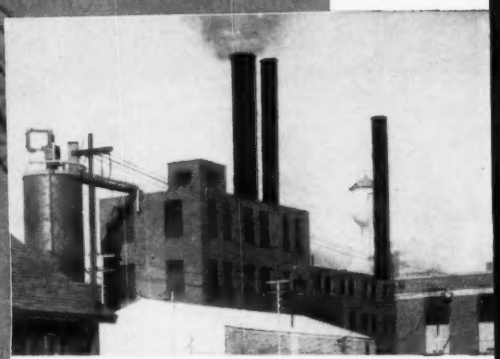
C-E

B-990

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

August 1955 *painter discovers dangerous corrosion in seven-year-old stack*

Prominent to corrosion-protected



Oscar Mayer Permaglas stacks measure 7′-6″ I.D. by ¼″ by 59′-6″ and 5′-0″ I.D. by ¼″ by 77′-6″. Larger stack (extreme left) handles approximately 182,000 lbs. per hr. of flue gas at 14.5% CO_2 at rated boiler load. Smaller stacks handle 149,000 lbs. of flue gas per hour at rated load.

FAST, EASY INSTALLATION—only precautions normally taken are use of pads under each sling, or sections can be easily erected using standard lifting fixtures. Permaglas sections are bolted together — no welding is required in the field.

Permaglas glass-protection gives you:

- 3 to 5 times longer life
- corrosion resistance regardless of excess condensate
- low maintenance — glass can't rust
- lightweight—lower foundation cost
- lower cost — glass protection now within reach of all
- tough, durable — remarkable resistance to impact or abrasion
- easy to install — no need for special equipment or highly skilled workmen

meat packer converts plant 100%

Permaglas® smokestacks

Glass-protected steel stands off corrosive acid action over 3 times longer than unlined steel smokestacks

OSCAR MAYER & CO., MADISON, WIS., took immediate action and converted to Permaglas smokestacks when they discovered a dangerous corrosion condition in two plain steel stacks.

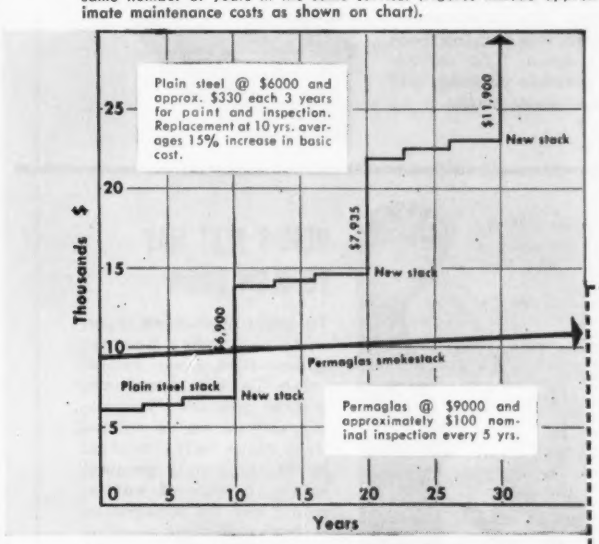
In their seven-year-old stack, the area above the lower flange of the top section was corroded to break-through for about one-half its circumference. The remaining half was about 1/16-in. thick. *Original thickness had been 1/4 in.* The top one-third of the stack was removed immediately for safety purposes. Investigation indicated metal thickness of 1/8 in. at the bottom of the center section and less than 3/16 in. at the base of the stack.

A small fifteen-year-old stack was similarly corroded by acid action of flue gas condensing out at low stack temperatures.

Recent installation of a third Permaglas stack, gives Oscar Mayer's Madison plant 100% protection against smokestack corrosion.

Why wait until trouble strikes? Why let corrosion cost you money? Surveys show that about 95% of all steel smokestack failures are caused by corrosion *inside* the stack. Stop this needless waste by converting to Permaglas smokestacks with exclusive glass protection *inside* and *out*. Contact your nearest A. O. Smith representative or write today giving details of your present stack problems or needs.

SAVE $23,135. WITH PERMAGLAS STACK — A 5'-0" by 100' Permaglas stack lasting a minimum of 30 years costs about $9,600. A plain steel stack of the same diameter and height, requiring replacement every 10 years, costs approximately $32,735, over the same number of years in the same service. (Figures include approximate maintenance costs as shown on chart).



Over three times longer service — Based on figures furnished by plain, carbon-steel stack users. The economy of Permaglas stacks is demonstrated in the above chart.

A number of Permaglas Smokestack Sales Territories are currently available. Write for details.

Through research A.O. Smith *... a better way*

A.O.Smith
CORPORATION
PROCESS EQUIPMENT DIVISION
PERMAGLAS SMOKESTACK SALES
MILWAUKEE 1, WISCONSIN
International Division: Milwaukee 1, Wisconsin

A. O. Smith Corporation, Dept. P-57
Milwaukee 1, Wis.

Please send me a copy of the NEW Permaglas Smokestack Bulletin No. MS-221.

Name.....

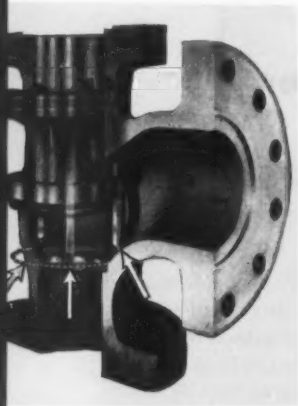
Firm.....

Address.....

City.....Zone.....State.....

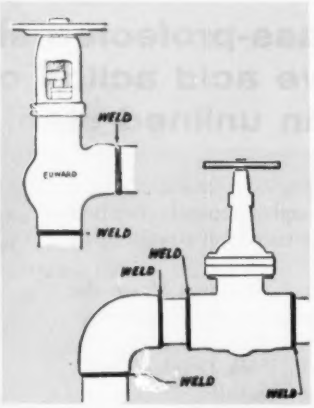
How To Get The Most

Tips on selection, installation and operation of steel



INTERNALLY-GUIDED VALVES MORE EFFICIENT

Internally-guided stop, check, and non-return valves are more efficient if the disk centers into the seat for positive shut-off. Illustration shows typical Edward check valve with three integral guide ribs.



ANGLE VALVES REDUCE INSTALLATION COST

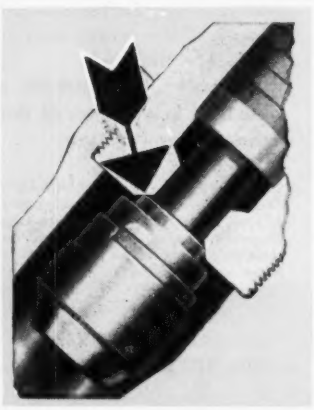
An angle stop valve can often be used instead of an elbow and a globe or gate valve. This reduces installation cost, makes bends, elbows and other components unnecessary, minimizes pressure drop.

STREAMLINING CUTS FLOW RESISTANCE

Internal streamlining, carefully designed and executed, cuts turbulence . . . reduces pressure drop . . . minimizes wear. Working with experimental half-models and the most modern laboratory equipment, Edward scientists incorporate the most precise streamlining in every valve.

BACKSEAT ISOLATES PACKING CHAMBER

Stop, non-return and blow-off valves can actually be repacked under pressure if they have a positive backseat, as illustrated. Here, a radiused disk nut contacts beveled bonnet seating surface, isolates packing from line pressure. This feature also protects packing, and reduces maintenance.



WELDED BONNET CAN'T LEAK

Ideal for severe service applications, small forged valves with welded bonnets are virtually leak-proof. This construction permanently maintains pressure tightness—eliminates need to periodically restress bolts. Weld can be removed, however, if internal repairs are ever necessary.

HERE'S BEST WAY TO BLOW DOWN

To begin blow-down, open wide the valve nearest boiler—then open second valve. To stop blow-down, reverse procedure by closing second valve first—then close valve nearest boiler. This puts greatest wear on second valve, which can be repaired or replaced *without shutting down boiler.*

Rockwell-Built Edward Valves

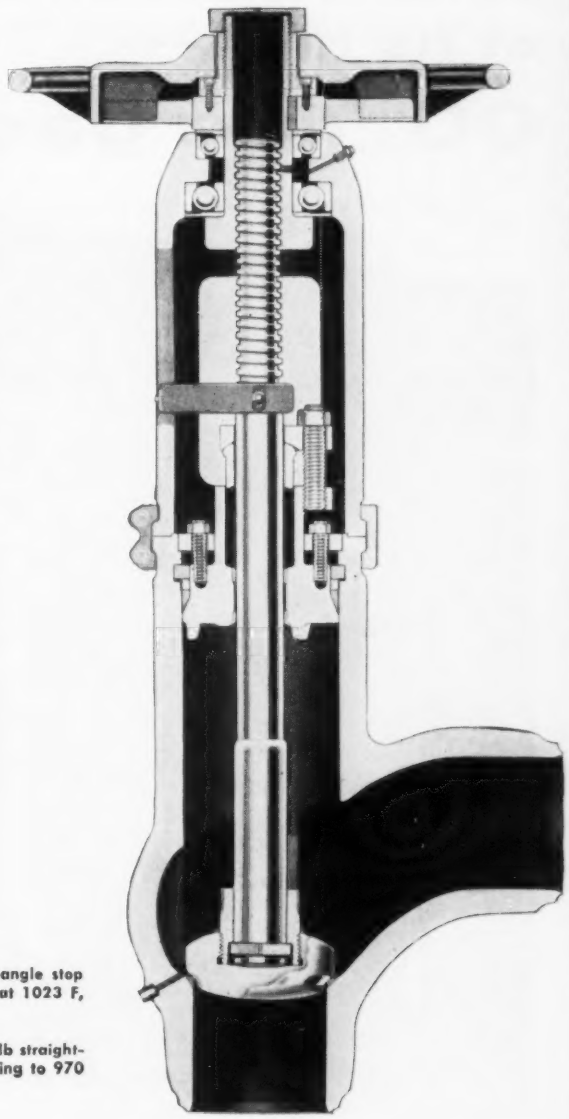
Value From Steel Valves

valves from Edward, long-time leader in the field

One way to cut the cost of initial installation—and future maintenance expense—of a piping system is to select the *right* steel valves. A competent valve engineer, for example, can often indicate where one angle stop valve can replace both an elbow and a globe or gate valve . . . reducing the costs of installation *and* cutting the number of piping components required. Other typical "secrets" of obtaining greater value from steel valves are shown in convenient clip-out form on the opposite page.

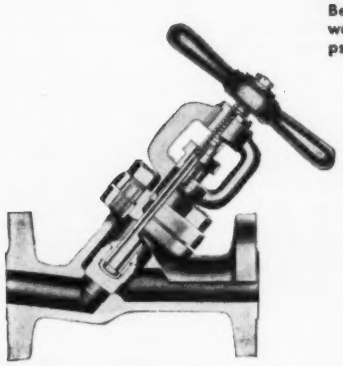
While he is well acquainted with piping conditions, a valve engineer concerns himself primarily with valves and their functions—and in this field, he is an acknowledged expert. His field experience, plus access to the results of continuous laboratory research, can put at your disposal a wealth of information on valve selection, installation, operation, maintenance and repair.

Such a man is your Edward Valve Representative. Technically trained, thoroughly experienced, his professional advice can save you headaches and money. At his disposal and yours are the results of continuing substantial investments in steel valve research. Many features, now accepted as standard in valves, were actually introduced by Edward. This process of constant development is reflected in Edward Valves . . . and in the spirit of your Edward Representative! He is at your disposal, to help you obtain the *most* for your valve dollar—both now and in the future. A card or a call will bring him . . . why not get in touch with us now?



Right: Fig. 7517Y cast steel 1500 lb angle stop valve for steam services to 1500 psi at 1023 F, water to 3600 psi at 100 F.

Below left: Fig. 641 forged steel 600 lb straightway blow-off valve for boilers operating to 970 psi saturated drum pressure.



Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

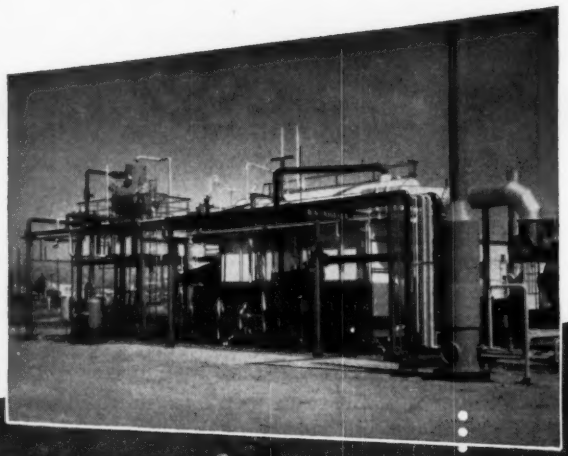
1230 WEST 145TH STREET

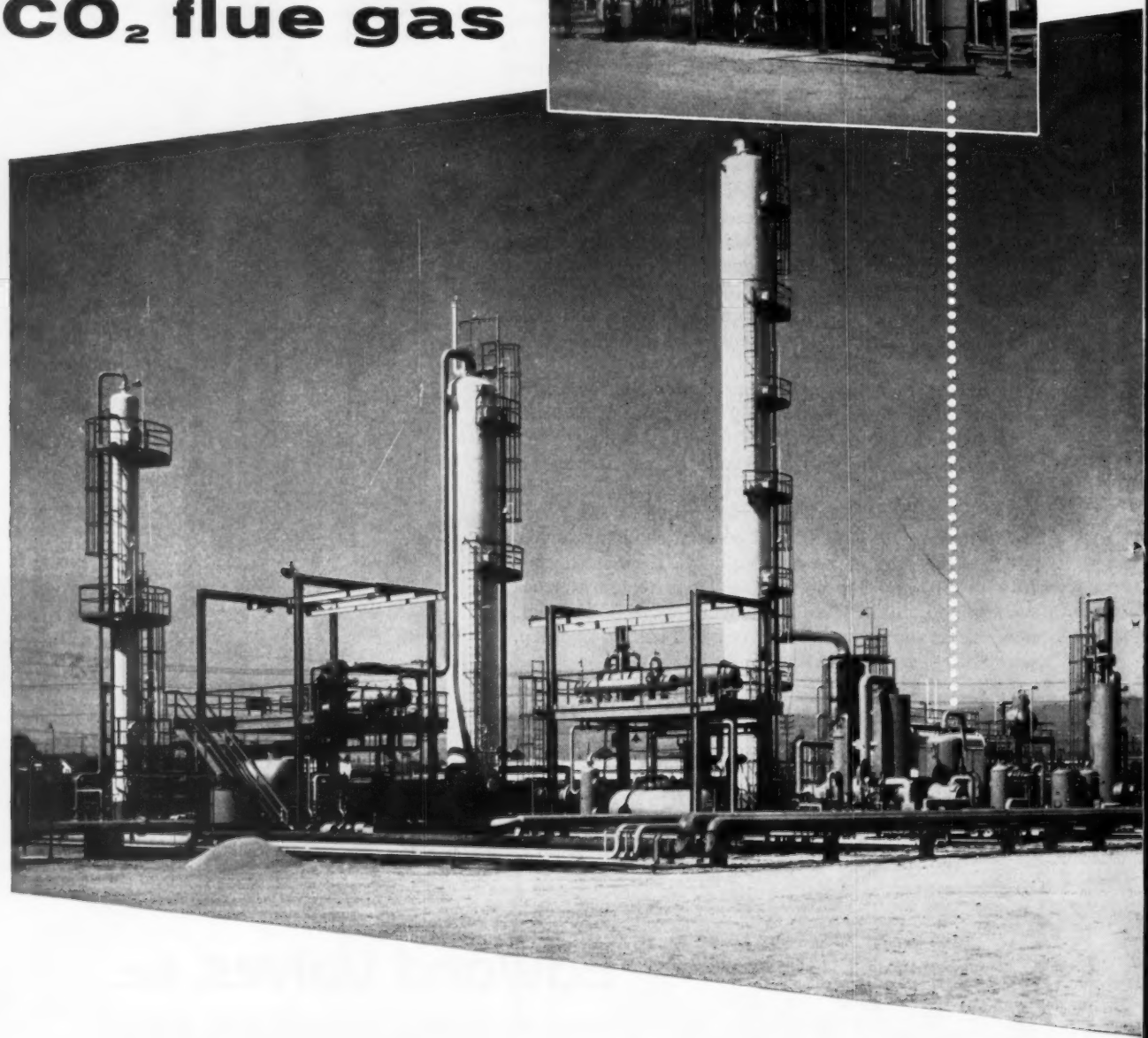
EAST CHICAGO, INDIANA

Everything depends on

ERIE CITY VL
selected because of its high---

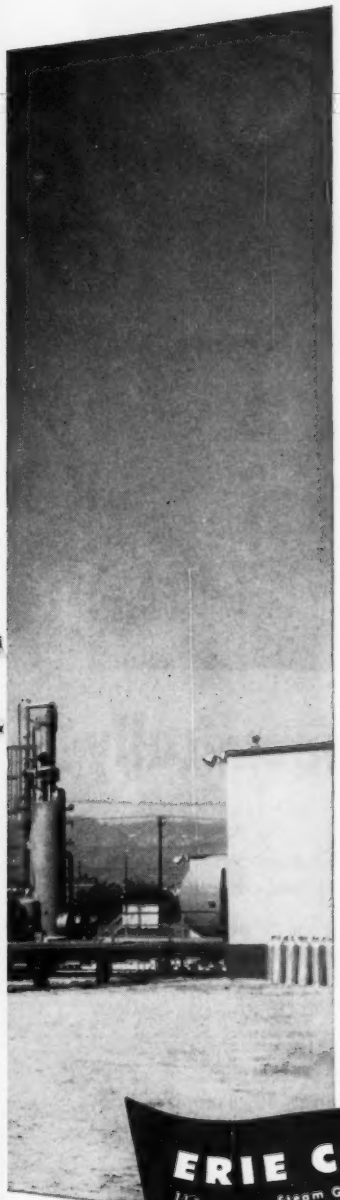
CO_2 flue gas





--the boiler flue gas ~ at this $1,500,000 Liquid plant

Liquid Carbonic Corporation, world's largest producer of CO_2 in liquid, gas and dry ice forms, operates the world's most automatic processing plant, of its kind, at Oakland, California



• Boilers used in the manufacture of dry ice and liquid CO_2 are specially designed and are an integral part of the process. When Liquid Carbonic specified the quantity of CO_2 to be produced at its Oakland, California plant, Erie City engineers met their stringent requirements. They designed and built the boiler, holding excess air to a minimum, while insuring complete combustion to obtain a high CO_2.

The entire operation at this plant is dependent upon the quantity of CO_2 that leaves the boiler. Unlike other boilers, steam production in this VL is incidental but is fully utilized to power the process.

Liquid Carbonic Corporation has for years found Erie City boilers dependable in this unique, severe application. The Oakland, California installation is one of many with Erie City boilers.

You, too, can depend on Erie City for sound engineering. Whatever type of steam generator you require, remember that Erie City designs and manufactures the most complete line, including all major components, to offer one single responsibility. There's over 117 years of experience to serve you.

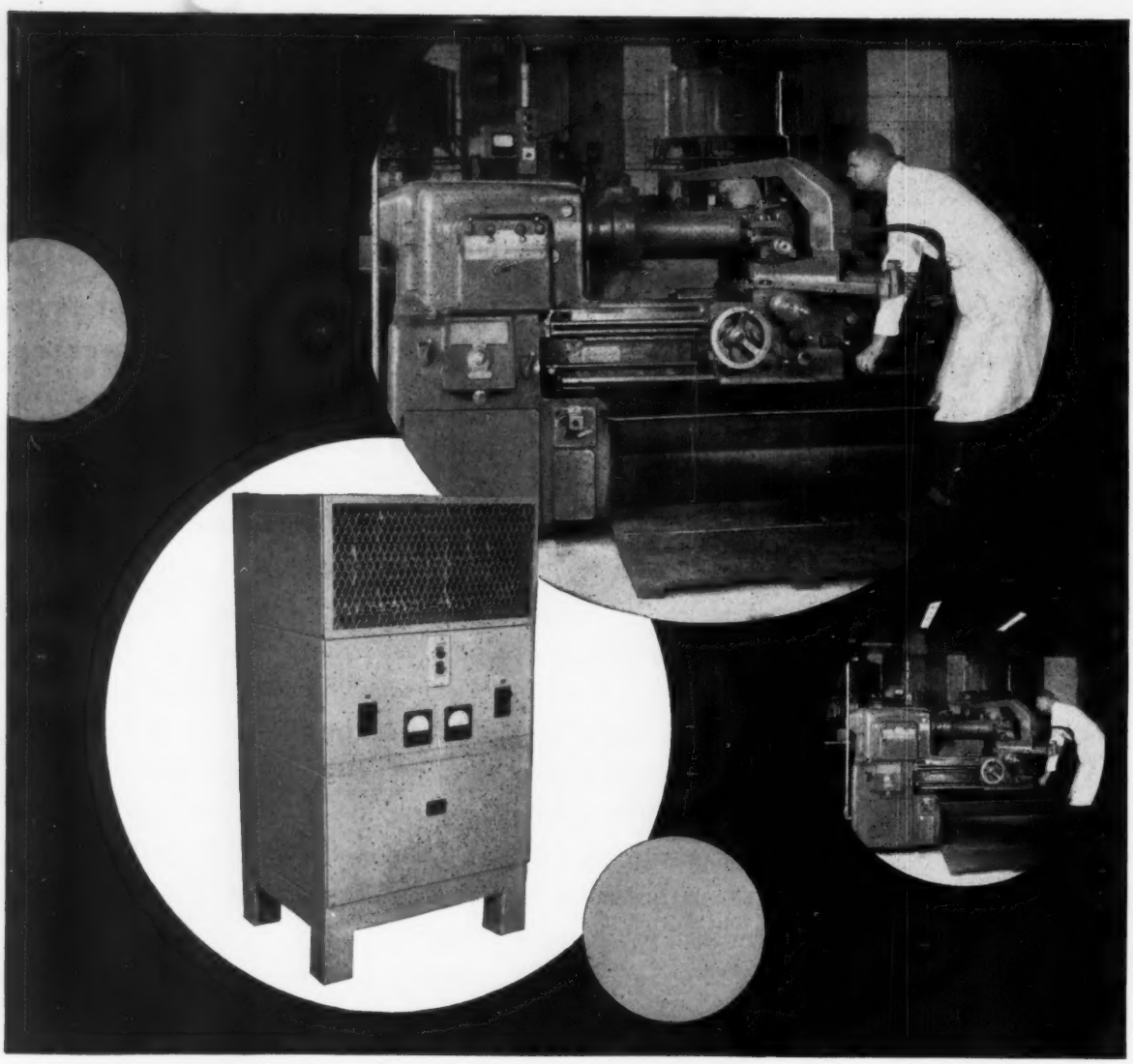
If you would like the complete story on the Erie City VL write for SB-432E.

ERIE CITY
117 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS



Dependable D-C ON THE SPOT...economically

Here is the low-cost, low-maintenance way to have d-c power exactly where it's needed—and it's more efficient than any other type of power conversion unit.

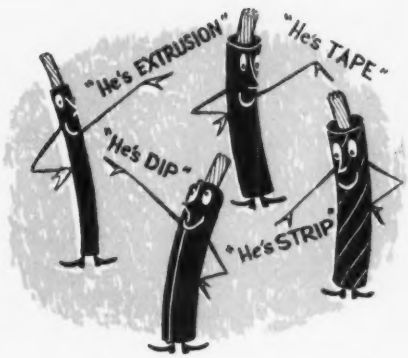
D-c power conversion units are available in ratings of ⅛ to 2 kw single-phase input and 1 to 100 kw three-phase input—ratings to meet your power requirements. And these units rely on long-lasting Rectox® selenium stacks which show less than 5% increase in forward drop after more than 16,000 hours of continuous life testing.

Westinghouse also furnishes a complete line of silicon units. For further information—call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-22032

YOU CAN BE SURE...IF IT'S Westinghouse

Hearken to this woeful fable of the man who bought a "bargain" cable



A. C. Current, a budding E. E.
Bought cables from many a source
But he didn't take time to consider, you see
That some last longer than others, of course

For some circuits *any* insulation will do—
For others, just one type is proper
But Okonite he never consulted, we rue,
As to which one should cover his copper.

It seems Mr. Current mistakenly thought
(Indeed, 'twas a total delusion)
That Okonite cable would cost him a lot
Whether made by strip, tape, dip or extrusion

Only Okonite insulates cables *all* ways
So our prices are not always highest
And thus when you ask us what cable to use
Our recommendation's unbiased.

The price *does* differ, depending on methods
(The type insulation and how it's applied)
The proof of the pie is in service records . . .
Which we would have gladly supplied.

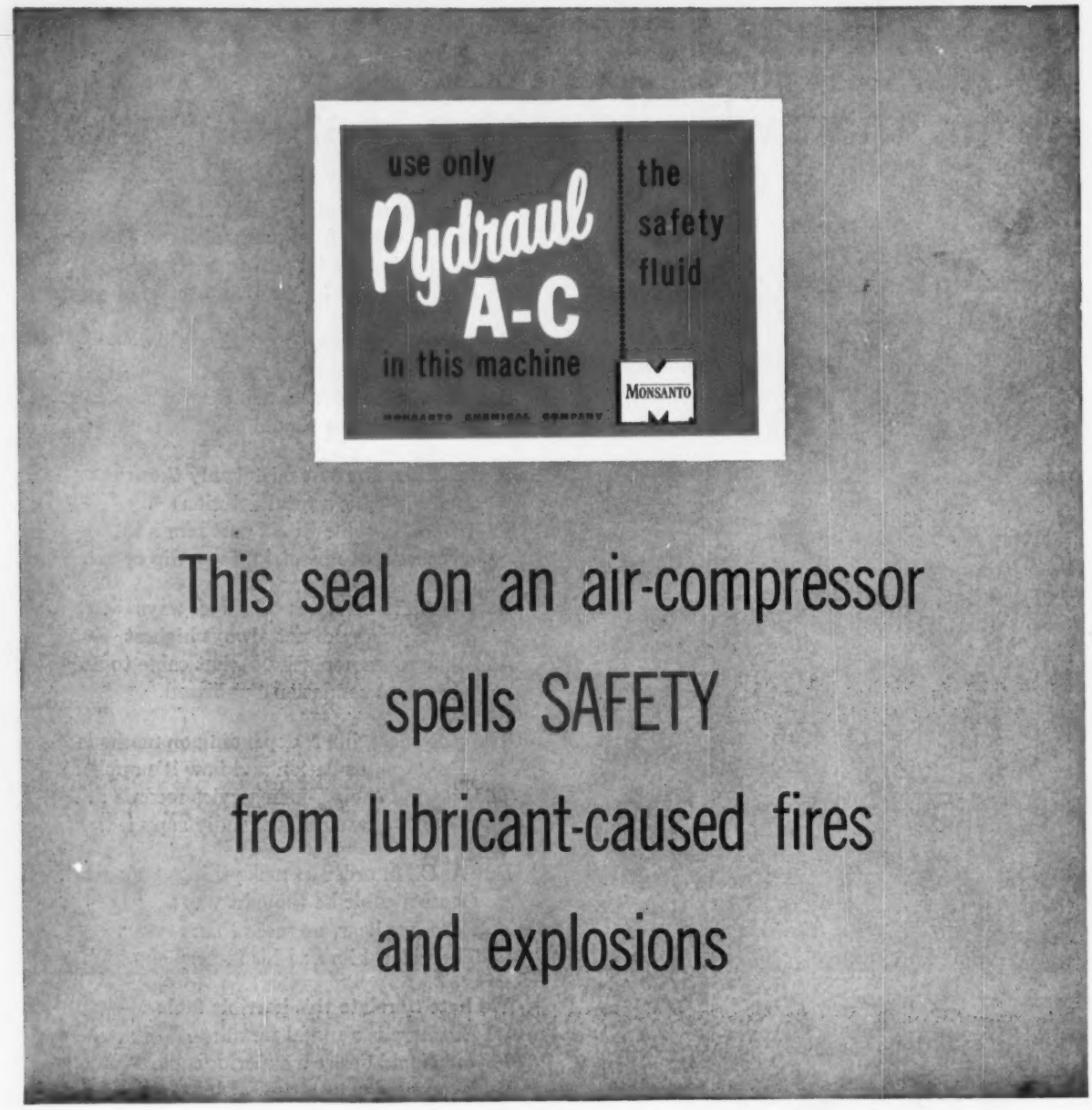
But A. C., in order to make things look good
Chose a cable he thought was a "buy"
It lasted, we hear, no more than a year,
Then blew him and his factory sky-high.

We hate to relate this horrible fable
But here is a moral for all:
If you should desire a superior cable
By extrusion or strip . . . by taping or dip
Just write us a letter, or call.

No matter *what* insulation or method of application you want (and we use them all) you'll get the best of its kind from Okonite. For a frank, down-to-earth discussion on cable insulating methods, write for Bulletin PW -1106, The Okonite Company, Passaic, N. J.

***where there's electrical power . . . there's* OKONITE CABLE**

4827



This seal on an air-compressor spells SAFETY from lubricant-caused fires and explosions

If you are operating one, ten or fifty air compressors in your plant, here's big news for you. The day of lubricant-caused compressor fires and explosions is *over!*

Now there's a new chemically tailored compressor lubricant called Pydraul AC that not only lubricates like a premium-grade petroleum oil—*it's fire-resistant!*

You'll realize additional savings in Pydraul AC's ability to minimize carbon deposits on air-compressor exhaust valves and air piping systems.

No conversion problems—just drain your flammable lubricant and replace with fire-resistant Pydraul AC—it's that easy.

Service-proved—two years of industry-wide service have confirmed Pydraul AC's *safety* and operating economies for power plants, gas transmission, chemical processing and the basic metalworking industry.

There's a fire-resistant Pydraul for every industrial hydraulic job: general-purpose Pydraul F-9; Pydraul 150 and Pydraul 60 for use in precision equipment; and Pydraul 600 for heavy equipment.

Pydraul: Reg. U. S. Pat. Off.

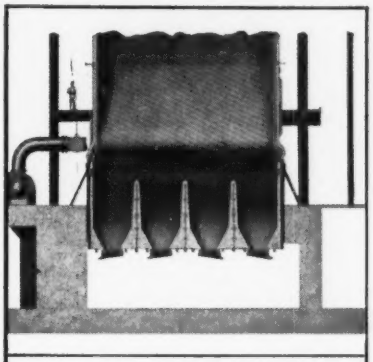
Write today for your copy of Pydraul AC bulletin.
Organic Chemicals Division
MONSANTO CHEMICAL COMPANY
Dept. PAC-73, 800 N. 12th Blvd., St. Louis 1, Mo.

MONSANTO

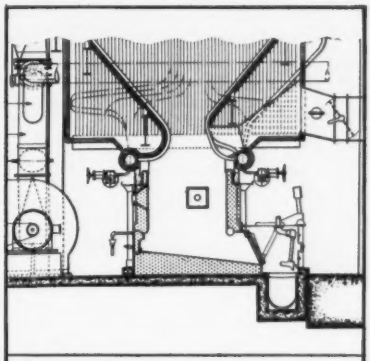
WHERE CREATIVE CHEMISTRY WORKS WONDERS FOR YOU

ASHPIT REFRACTORY CASTABLES

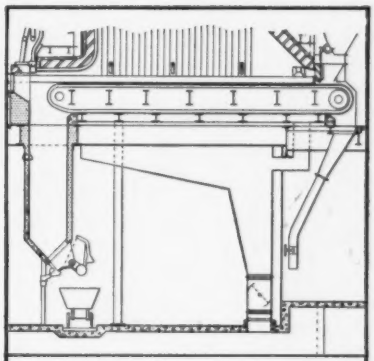
Rugged B&W Kaocretes Stand Up Under Abrasion and Erosion



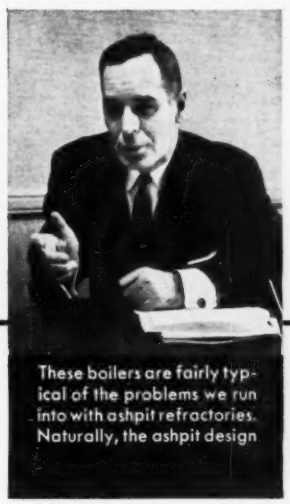
Erosion, due to dry ash sliding down the hopper, is the big problem in this ashpit.



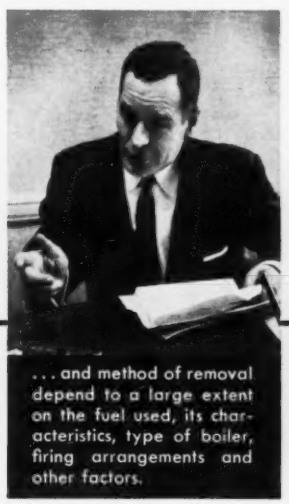
Water jets can cause abrasion of ashpit floor refractories, and water splattered on the walls may cause spalling.



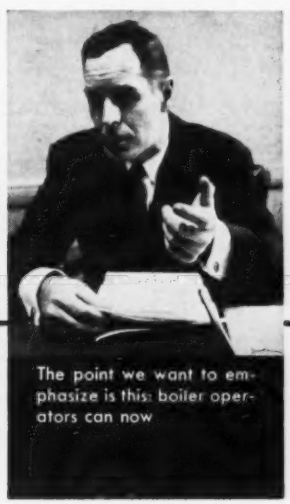
Continuous deposits of ash from a stoker-fired boiler have an abrasive effect on this ashpit lining.



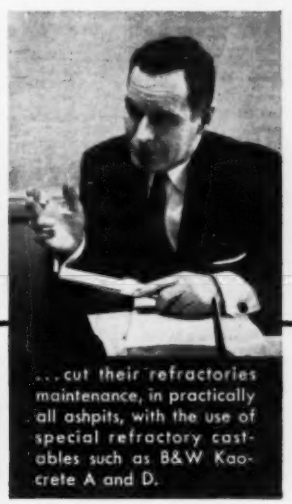
These boilers are fairly typical of the problems we run into with ashpit refractories. Naturally, the ashpit design



... and method of removal depend to a large extent on the fuel used, its characteristics, type of boiler, firing arrangements and other factors.



The point we want to emphasize is this: boiler operators can now



... cut their refractories maintenance, in practically all ashpits, with the use of special refractory castables such as B&W Kaocrete A and D.

How B&W Refractory Castables Cut Ashpit Maintenance

When you consider the punishment ashpit refractories have to take, it's no wonder they are usually the most expensive item of refractories maintenance.

In almost all ashpits, they have to stand up under abrasion and erosion of the ash itself. If the ash is quenched in a water-filled hopper or with sprays, the hot ashpit walls may be splattered with water. The refractories must have spalling resistance to withstand this thermal shock. If the ash is removed by "raking out" or by high velocity water jets, the lining must be able to take this kind of abuse.

How do refractory castables stand up in this kind of service? Here's an example: A public utility made a trial installation of B&W Kaocrete in one of their ashpits. It gave over two years more maintenance-free service than the refractory previously used.

On the strength of this performance, another ashpit was lined with B&W Kaocrete—and this was a tough one. Two opposing high velocity sprays were used for quenching and ash removal. Water splattered on the ashpit walls, which meant the lining was subjected to severe thermal shock. In addition, the jets had an abrasive effect on the floor.

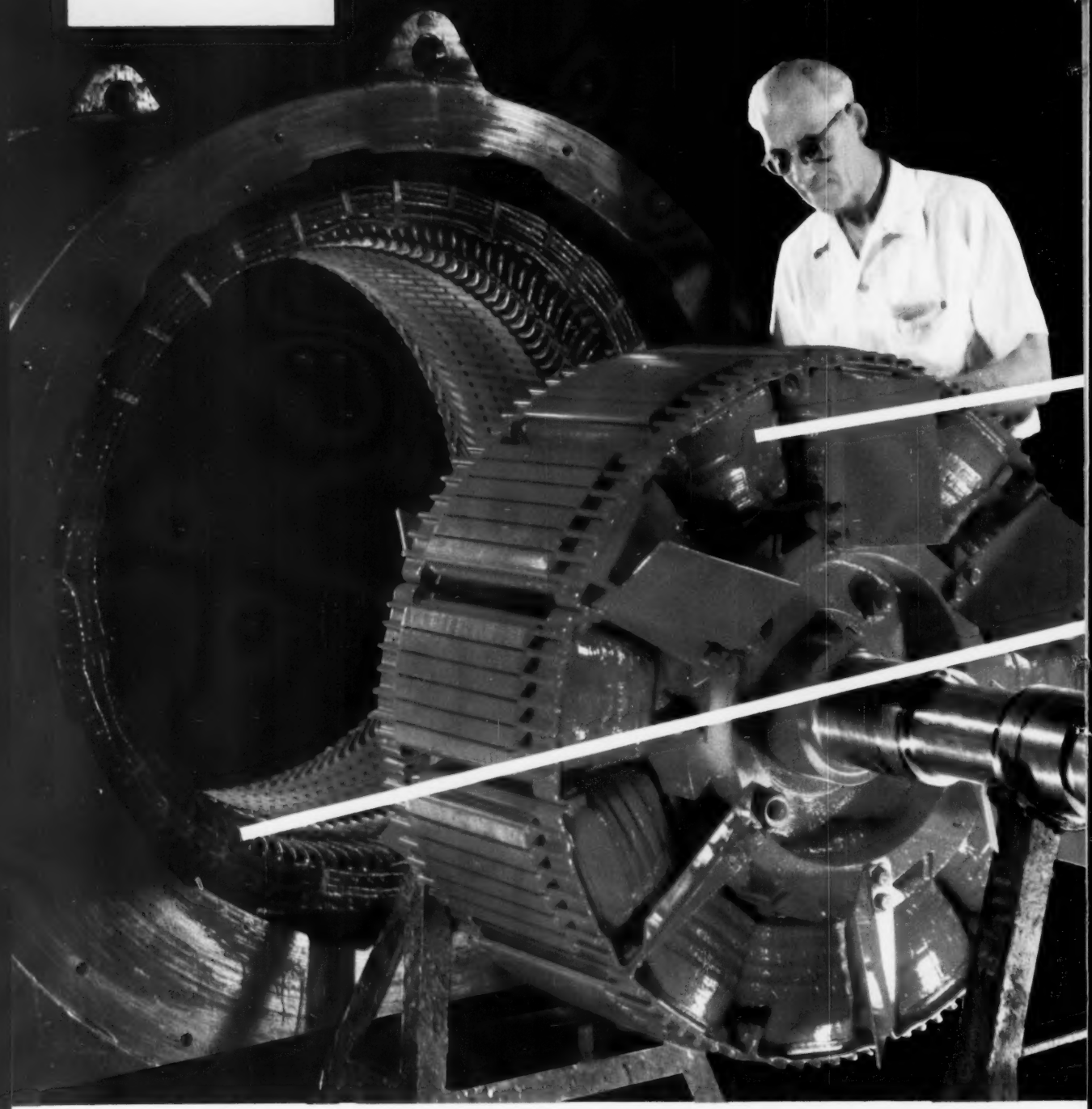
The service was superior to the refractories used before. As a result, this public utility is using B&W Kaocrete to line all ashpits.

These are examples of installation savings made possible by using refractory castables instead of brick. B&W Kaocrete D was specially developed to have unusually high resistance to abrasion, erosion and spalling—properties that are essential in ashpit service. For less severe operating conditions, B&W offers Kaocrete A, which will also give satisfactory service in many types of installations. Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

THE BABCOCK & WILCOX CO.
Refractories Division
General Offices:
161 East 42nd St., New York 17, N. Y.
Works: Augusta, Ga.

B-839

ONLY Allis-Chalmers



ALLIS-

MOTORS are "double protected"

New Integrated Field Coils Plus *Silco-Flex* Stator Insulation Provide Superior Motor Protection... Under Any Operating Conditions

1

Integrated Field Coils are bonded in heat-stabilized resins, enclosed in a resin-impregnated sheath of oriented glass fibers and bond-locked on the pole structure . . . dimensionally stable to withstand heating and thermal shock, vibration and fatigue at elevated temperatures . . . sealed throughout against atmospheric contaminants and fully protected against destructive forces.

2

***Silco-Flex* Insulation** provides a homogeneous, void-free insulating wall of silicone rubber on stator coils. It is unexcelled in life and thermal stability at high temperatures . . . resistant to most chemicals, water, weather . . . outstanding in flexibility and resilience . . . able to withstand abrasion and corona . . . resistant to physical and mechanical forces.

Exclusive Allis-Chalmers "double protection" is available on large electrical machines with operating temperatures through Class B range.

Silco-Flex is an Allis-Chalmers trademark.

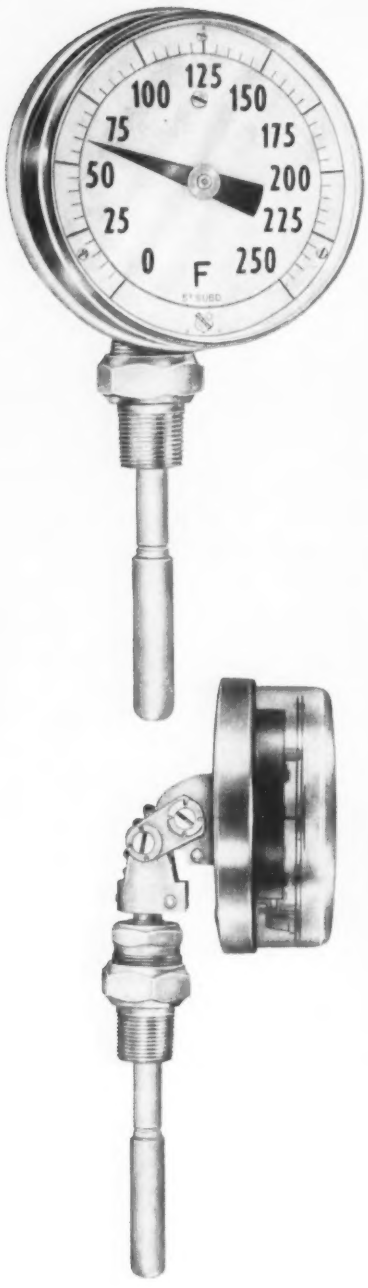
For more information on these quality insulation systems contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin for Integrated Field Coil Bulletin 05R8525 and *Silco-Flex* Insulation Bulletin 05R8341.

Allis-Chalmers "Double Protection," with integrated field coils and Silco-Flex stator coil insulation, adapts this 600-hp, 2300-volt, 600-rpm synchronous motor to the most severe operating conditions.

CHALMERS

A-C ALLIS-CHALMERS

A-5221



NEW

MERCURY ACTUATION

IN A MODERN 'AMERICAN'

"Every Angle" DIAL THERMOMETER

If you expect the most for your money in readability, accuracy and durability, here is the best dial thermometer investment you can make. The 'American' Mercury-Actuated "Every Angle" Dial Thermometer provides a combination of five major advantages found in no other thermometer:

"Every Angle" Set-ability. You can turn the dial to any angle within 180° on two axes. Whether installed above or below eye level – to the right or left of the reading point – you get easy face-to-face readings.

Fast, Accurate Indication. Mercury – one of the most sensitive heat transfer mediums – makes possible readings up to 1000° F. in a few moments with accuracy within 1% of the entire scale range.

Surest, Sharpest, Easiest Readings. The Maxivision® dial – a split-level dial – is constructed so that the graduations and pointer are on the same plane. No perspective effect. No parallax error in reading.

Best in Visibility. The cover is a large, durable, clear glass dome without bezel. No dark shadows dim the dial to hinder reading accuracy.

Stainless Steel Construction. Movement, capillary tubing, stem, case and cover mounting – all are stainless steel.

Where resistance to corrosion is important, where appearance and cleanliness are essential, the 'American' Mercury-Actuated "Every Angle" Dial Thermometer is ideal. It is rugged – has every quality required for the toughest services, indoors and outdoors. From the standpoint of economy, the "Every Angle" feature alone can save money in new piping specifications and when changing existing piping. It reduces the need to re-specify and stock a variety of fixed stem thermometers.

Dial Size: 4½". *Temperature Ranges:* –20/120° F. to 200/1000° F. *Stem Lengths:* 4", 6", 8", 12", 18" and 24". Separable sockets available.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has complete information on the 'American' Mercury-Actuated "Every Angle" Dial Thermometer. Call on him to fulfill your requirements with fast delivery from local stocks.

1850 AMERICAN U S A

AMERICAN INDUSTRIAL INSTRUMENTS

MAXWELL MANNING MM&M & MOORE INC. TRADE MARK

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-M'CROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn., and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

I-R CONDENSERS AND AUXILIARIES

will serve new, ultra-modern semi-outdoor plant in Arizona

To SERVE the booming "Kilowatt Country" of Arizona and vicinity, the Salt River Power District is building a new 200,000 kw semi-outdoor steam plant of completely modern design. This Agua Fria Steam Plant, under construction by The Bechtel Corporation, will feature the latest advances in power plant technology, including closed-circuit television for boiler room supervision.

Each of the station's two 100,000 kw turbo-generator units will be served by an Ingersoll-Rand 50,000 sq. ft. rectangular surface condenser. Auxiliary equipment includes I-R condensate and circulating pumps and steam-jet ejectors.

Here, as in all Ingersoll-Rand steam plant equipment, maximum service continuity and long-range *dependability* are primary factors in design and construction. The performance of similar equipment, in leading power plants from coast to coast, has demonstrated its exceptional life-expectancy in continuous, heavy-duty service. Ask your I-R representative for full details on the equipment best suited to your needs.

INGERSOLL-RAND EQUIPMENT FOR THE AGUA FRIA STEAM PLANT —

2 Rectangular Surface Condensers, each 50,000 sq. ft. single-pass, vertically divided.

2 Steam-Jet Ejectors, twin-element, two-stage with surface type inter- and after-condensers.

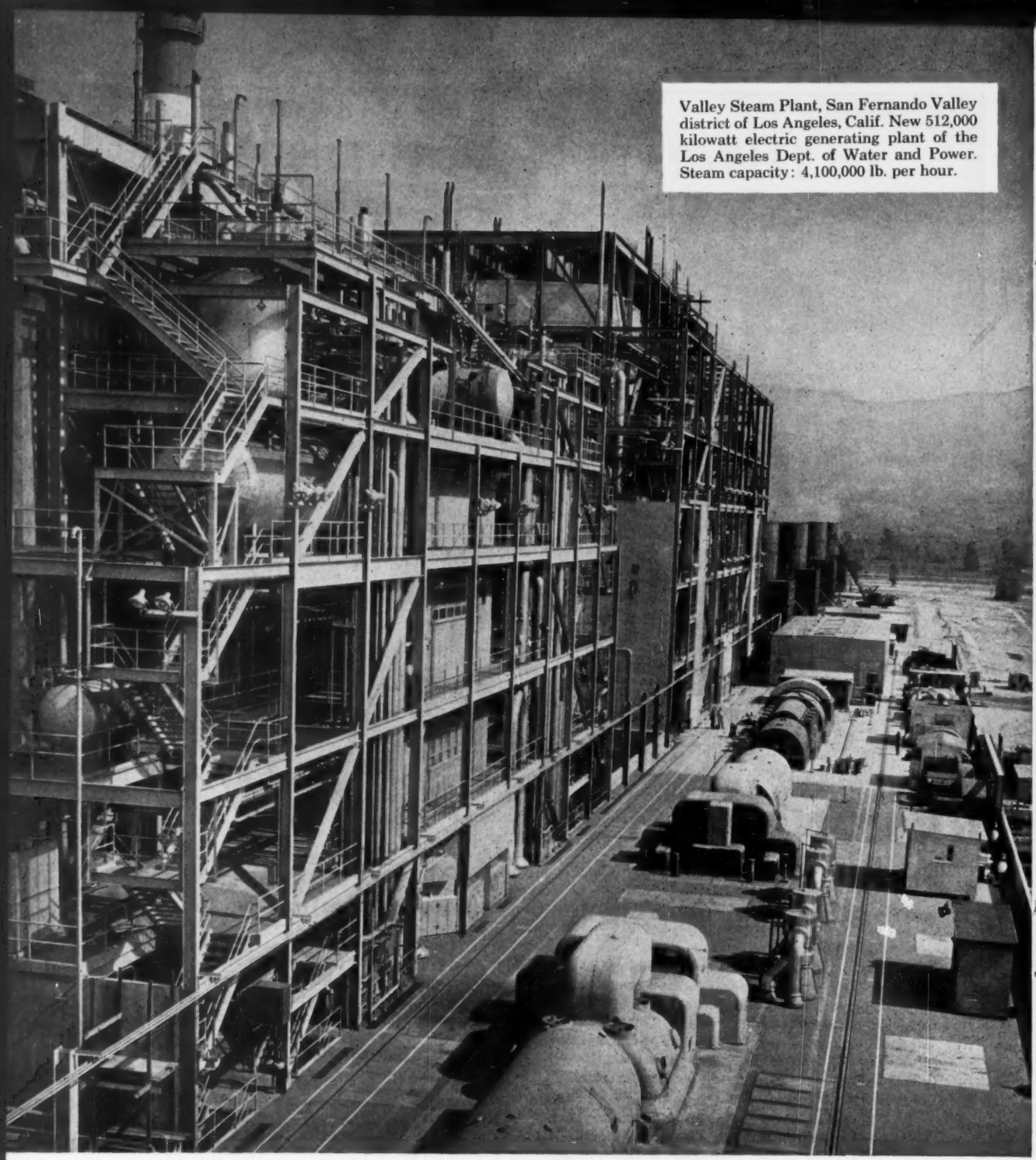
4 Vertical Condensate Pumps, each a three-stage unit rated 1400 gpm, 250 ft. head.

4 Horizontal Circulating Pumps, each a single-stage double-suction unit rated 41,000 gpm, 57 ft. head.

4-427

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES



Valley Steam Plant, San Fernando Valley district of Los Angeles, Calif. New 512,000 kilowatt electric generating plant of the Los Angeles Dept. of Water and Power. Steam capacity: 4,100,000 lb. per hour.

How big Valley Steam Plant demineralizes

• Valley Steam's feedwater requirements are typical for today's modern, high-capacity stations. Its raw water supply, delivered from the Los Angeles Owens River Aqueduct, contains 132 ppm total solids but is high in dissolved silica (18 ppm). The 1500 psig and 1850 psig boilers require a large amount of high quality feedwater.

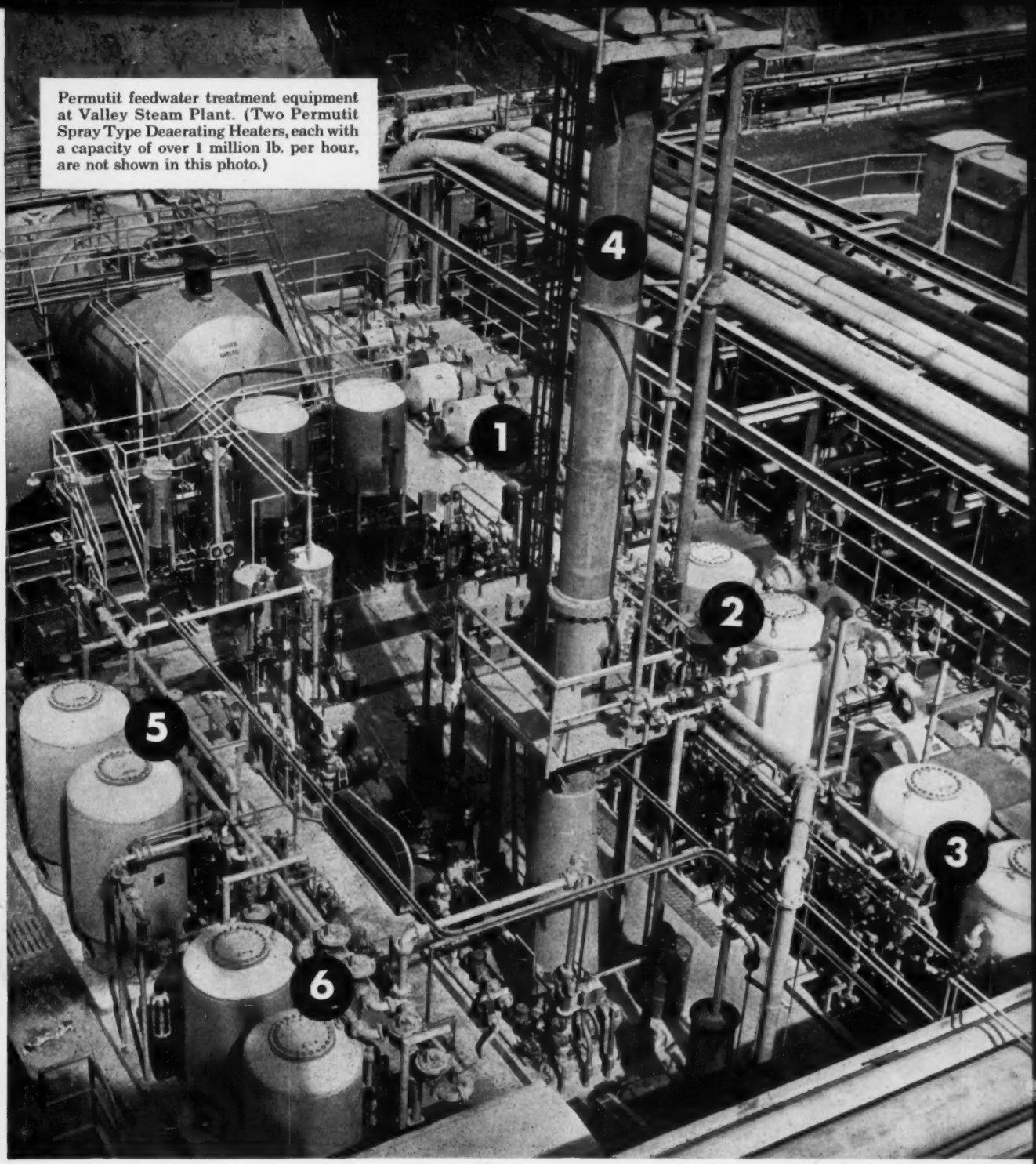
The 4-step PERMUTIT Demineralizer was custom-designed for this problem . . . not only in size, arrangement and number of ion exchange units, but also in the selection of the ion exchange resins.

That's why Permutit's broad experience with many different demineralizing systems and its manufacture of ion exchange resins as well as equipment are of particular value in solving large-plant water problems.

The Permutit Company, Dept. P-5, 330 West 42nd St., New York 36, N. Y. Permutit Company of Canada, Ltd., 207 Queens Quay, Toronto 1, Ontario.

PERMUTIT EQUIPMENT FOR POWER PLANTS:

Demineralizers • Zeolite and Hot-Process Softeners • Dealkalizers • Deaerating Heaters • Pressure and Gravity Filters • Chemical Feeders • Aerators • Blowoff equipment • CO_2 Indicating Recorders • Zeolites and Resins • Instrument Panels • Control Cubicles



Permutit feedwater treatment equipment at Valley Steam Plant. (Two Permutit Spray Type Deaerating Heaters, each with a capacity of over 1 million lb. per hour, are not shown in this photo.)

its feedwater with **PERMUTIT**® equipment

1 Diatomite filters (behind column) remove dirt and other suspended matter . . . keep ion-exchanger beds clean for top efficiency.

2 Primary hydrogen cation units contain Permutit Zeo-Karb® . . . remove metallic cations such as calcium, magnesium, sodium.

3 Weakly basic anion units contain Permutit A exchange resin . . . remove chlorides, sulfates, nitrates.

4 Vacuum deaerator removes CO_2 at low cost. Reduces the load on the second stage anion exchangers.

5 Secondary hydrogen cation units (Zeo-Karb) "polish" water by removing "slippage" from first cation units.

6 Strongly basic anion units contain Permutit S-2 resin . . . remove dissolved silica . . . also catch "slippage" from first anion units.

Quality of effluent: Zero free CO_2, under 1 ppm total solids, under 0.2 ppm silica.

For highest efficiency and lowest operating cost, the regeneration of the demineralizing equipment is completely automatic and operated by Permutit instrument panels and control cubicles.

for every temperature range—
for every operating condition

Carey

SERVICE-PROVED INSULATIONS

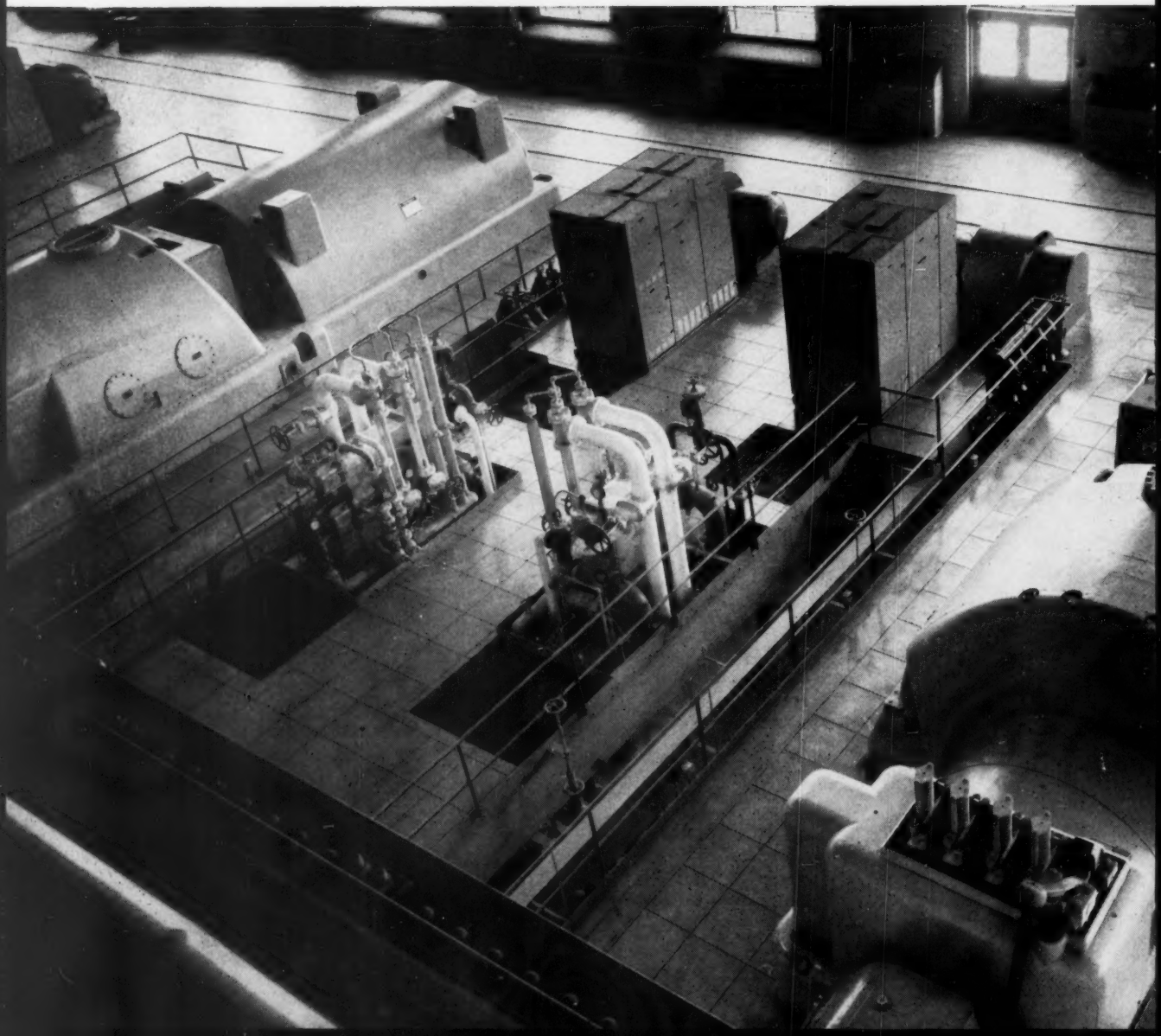
Service Report on Carey Insulations at:

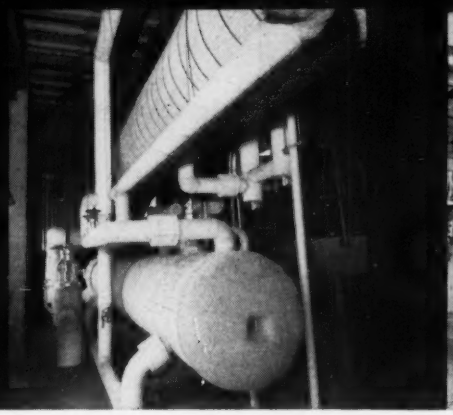
INDIANAPOLIS POWER & LIGHT COMPANY

White River Generating Station, Campbells, Indiana

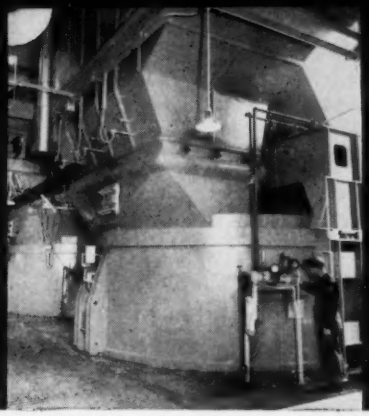
IP&L's White River Generating Station is the largest of the company's five plants. Between them, they supply power throughout 528 square miles of central Indiana. The White River installation alone has a top capability of 376,000 kilowatts and is the main source of power for the sprawling Indianapolis metropolitan area. The last of the plant's six units was completed in October of 1956. Total cost for all units was $51,000,000.

Lower shrinkage, greater moisture resistance make **Carey alltemp**





Carey Alltemp (inner layer) and 85% Magnesia (outer layer) are used on these high pressure heaters and connecting piping. Operating temperatures: 800°-1000°F.



IP&L employee Charles Bass checks pump which propels oil through lubrication system on air-preheater. Carey Alltemp-85% Magnesia combination used on preheater and gas ducts.

and 85% magnesia perform best "under pressure"

White River Generating Station's six boilers are capable of producing over 3 million pounds of steam per hour. Firebox temperatures inside the boilers run as high as 2400°F., and pipe temperatures often exceed 1000°F. This really puts the pressure on Carey Alltemp and 85% Magnesia insulation which cover a large part of the plant's 55 miles of piping. Here are a few of the factors which help these Carey insulation products perform better under the toughest possible operating conditions:

Less Shrinkage — At high temperatures, Carey Alltemp has less than one-half the shrinkage of competitive insulation products. Percentage of heat loss is directly affected by percentage of shrinkage —less heat loss, greater insulating efficiency.

Better Balance — Operating temperatures at White River range from 100° to 1000°F. where Carey Alltemp and 85% Magnesia are used. These products retain their thermal efficiency over this complete temperature range, with only a slight variance in conductivity.

Greater Resistance to moisture, caustics, vibration and shock. Won't shatter or change shape. (Carey Alltemp and 85% Magnesia are easy to cut and fit, too—save application time and costs!)

At IP &L's White River Station, Carey products are meeting a wide variety of heat insulation requirements. They've been on the job since the plant's first unit was constructed in 1948. Repeat orders on subsequent units furnish unmistakable proof of Carey's performance "under pressure".

◀ Auxiliary steam piping at IP&L's White River plant insulated with a combination covering of Carey Alltemp and 85% Magnesia. Operating temperature: 1000°F.

Better Products for Industry Since 1873

THE PHILIP CAREY MFG. COMPANY

Lockland, Cincinnati 15, Ohio

The physical characteristics of Carey insulation products are measured and tested with scientific precision by Mellon Institute of Industrial Research, Pittsburgh, Pa. This is your assurance of the accuracy of Carey product specifications. Mail coupon for literature and sample specifications, or write for the name of your Carey Industrial Sales Engineer.

THE PHILIP CAREY MFG. COMPANY, Dept. P-57
Lockland, Cincinnati 15, Ohio

Please send literature and sample specifications on

☐ Alltemp ☐ 85% Magnesia

☐ Please have your Industrial Sales Engineer call.

NAME_____ TITLE_____

FIRM NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

Maintenance engineering

You can arrange to have a Honeywell service engineer visit your plant at regular intervals to inspect, clean, and adjust your instruments and controls. He's factory-trained and field-experienced in keeping good instruments in top operating condition. If an emergency should arise, a phone call will bring a Honeywell service engineer to your plant in a hurry.

Spare parts, in a rush

A Honeywell branch office near you can be your storeroom for standard parts . . . in addition, the Parts Depot in Philadelphia carries a complete stock of all normally used parts. With Honeywell stocking your spare parts, you save storage and inventory control costs. Most shipments are made within 24 hours after orders are received.

Service is the

Practical service training

The tuition-free Honeywell Training School teaches your instrument technicians the most up-to-date maintenance methods, fits them for the kind of problems they may encounter on the job. Intensive courses range from two to fourteen weeks.

Application engineering

Experienced Honeywell application engineers know your industry and processes. They design *complete* systems of instrumentation, reducing the work of your own engineering staff. From the broad Honeywell line, they recommend instruments that are exactly right for the job. And because Honeywell supplies all types of instruments, recommendations are made without bias. Service engineers will, if needed, help with installation and startup of your system.

big extra you get with Honeywell instrumentation

Honeywell offers you far more than instruments. You get service whenever and wherever you need it . . . service that begins when you first decide you need instruments, and continues long after they're installed. This service is always conveniently close at hand, for there are more than 110 Honeywell sales and service centers located strategically throughout the U. S. and Canada.

Prompt, competent service by nearby field specialists is an important plus-value of Honeywell instrumentation. Your local Honeywell sales engineer has all the facts on this service as it relates to your instrumentation needs. Give him a call . . . he's as near as your phone.

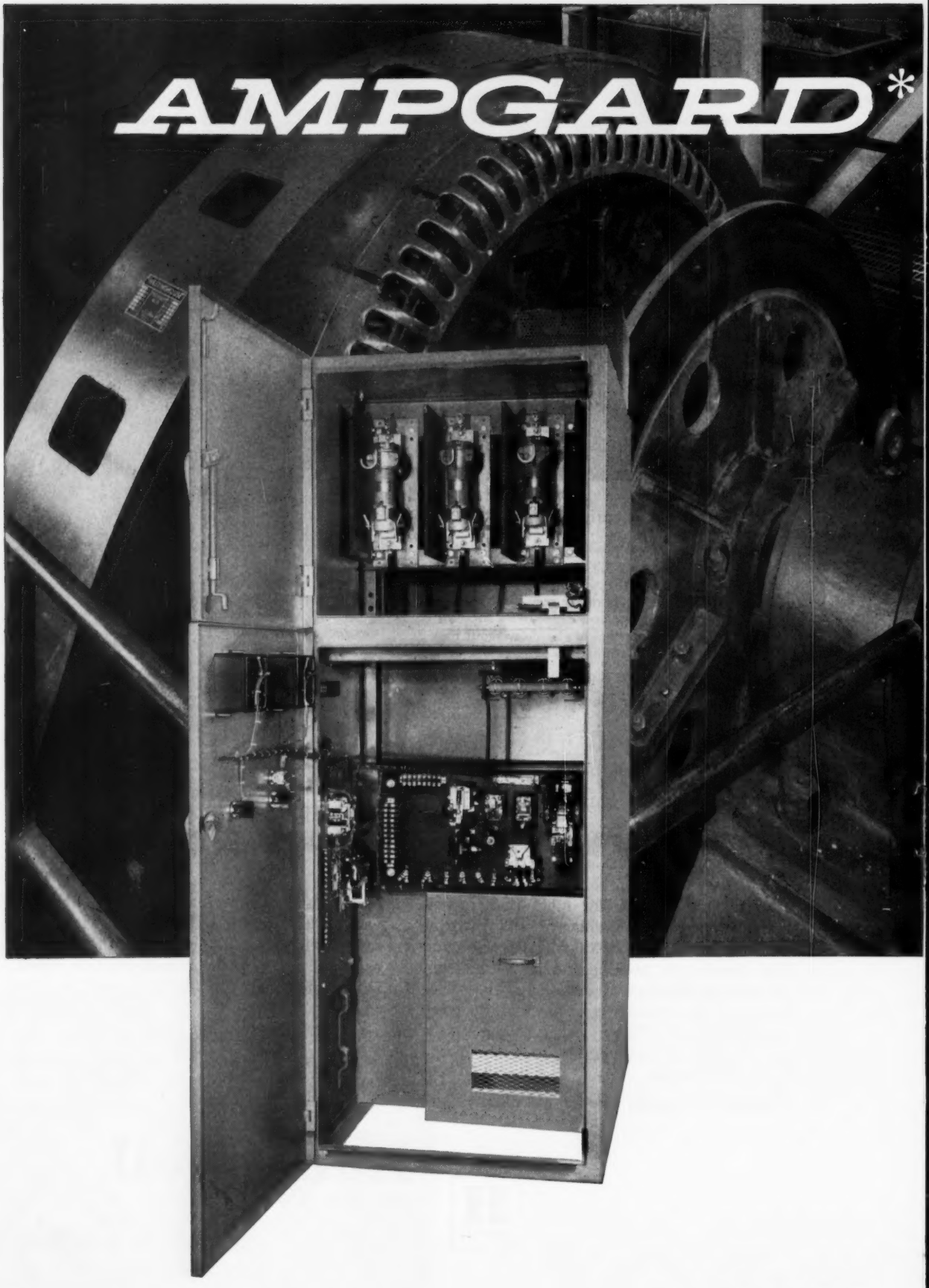
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

H HONEYWELL

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls


AMPGARD*

automatic synchronizing assures top motor performance

Westinghouse high-voltage synchronous motor starters with . . .

Automatic Synchronizing . . . assures a good start every time. Maximum synchronizing torque results from applying the field excitation at the most favorable rotor position. Starting time is the shortest possible, because the motor is synchronized as soon as it accelerates to pull-in speed.

Motor Protection . . . separate relays protect stator against sustained overloads and also protect rotor damper windings against failure of the motor to start. Motor is automatically stopped if it pulls out of step.

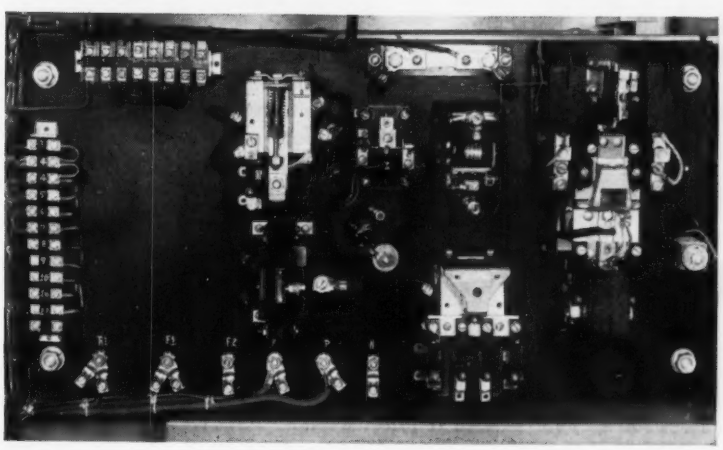
Complete Circuit Protection . . . assured for high-voltage starting by Westinghouse type BAL fuses that safely interrupt fault currents on systems up to 250,000 kva. This is the kind of protection your plant system needs with the ever-increasing voltages being supplied today.

For complete information about AMPGARD, the most complete line of high-voltage starters available to industry, call your local Westinghouse sales engineer or write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pa.

*Trade-Mark

J-22025

YOU CAN BE SURE...IF IT'S Westinghouse



SLIPSYN® PANEL
the heart of Westinghouse Synchronous Motor Starters

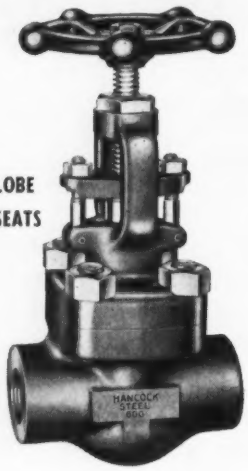
This panel, with the exclusive Westinghouse ASR relay, controls automatic synchronizing on start-up, protects motor windings, shuts down motor in the event of loss of synchronization and protects damper windings if the motor fails to start. Westinghouse synchronous starters with SLIPSYN panels guarantee a good start every time.

*Registered Trade-Mark

NEW 600# STEEL

NEW

TYPE 5500 — 600# GLOBE
INTEGRAL HARD-FACED SEATS
"500 Brinell"
Stainless Steel Discs.



Especially suitable for high pressure steam and temperature services in power plants. **Sizes:** ¼" thru 2". **Standard Materials:** Forged carbon steel A.S.T.M. A-105 Gr. II. **Alternate Body and Bonnet Materials:** 1¼% Chrome, ½% Moly Steel, A.S.T.M. A-182 Gr. F-11. **Connections:** Screwed and Socket Weld Ends. For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F.

NEW

TYPE 5520 — 600# GLOBE
TYPE 5530 — 600# ANGLE
RENEWABLE "300 BRINELL" STAINLESS STEEL SEATS
"500 Brinell" Stainless Steel Plug Discs.

Ideal for processing plants and general industrial service. **Sizes:** ¼" thru 2". **Standard Materials:** Forged carbon steel A.S.T.M. A-105 Gr. II. **Alternate Trims:** 18-8 Type 316 Stainless Steel; Monel. **Alternate Body and Bonnet Materials:** 5% Chrome, ½% Moly Steel, A.S.T.M. A-182 Gr. F-5; 18-8 Type 304 Stainless Steel A.S.T.M. A-182 Gr. F-304. **Connections:** Screwed, Socket Weld and Flanged Ends. **Screwed and Socket Weld Valves:** For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. **Flanged Valves:** For all pressures up to 600 psi at 850°F. O.W.G. — 1440 psi at 100°F.

These 600# bolted bonnet forged steel valves really make sense to every man who knows the economy of quality valves. Designed into them are plus values that substantially reduce profit-draining production shut-downs, maintenance problems and inventory costs. Built as companions to the widely-used Type 950 Hancock 800# Steel Gate Valves, they offer:

Thick, Rigid Body and Bonnet Flanges that can withstand more than ten times the rated pressure of the valve. The flanges butt — no bending, no distortion.

Re-usable Flexitallic Bonnet Gasket, in combination with the rigid body and bonnet flanges, prevents bonnet joint leakage. The gasket is a spiral-wound ribbon of stainless steel with asbestos filler and spring-like compressibility. It rests in a groove in the body flange — cannot blow out even if pressures exceed ten times the rating of the valve. *Hancock 600# Steel Valves are the first globe valves to use this important feature.*

Maximum Use of Stainless Steel. Even the stem, swing bolts, nuts, thread bushings and packing gland followers are stainless steel — your assurance of quality that saves throughout the long life of these valves.

The 5500 Line of Hancock 600# Steel Valves is available in Globe, Angle, "Flocontrol," Lift Check and Hi-Pressure Drop designs. Whatever your needs, you can buy these valves with complete confidence in their functional perfection. Like all other Hancock Valves, they are precision engineered and carefully manu-

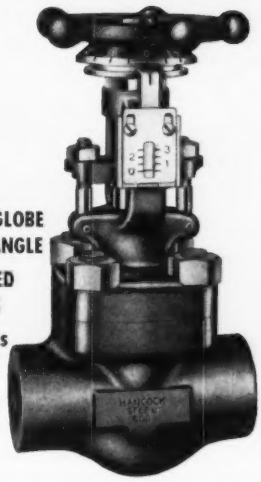
HANCOCK VALVES

PHONE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR. His broad knowledge and experience can be of real value to you. **Let him help** you select the right Hancock Bronze and Steel Valves for all your service requirements.

HANCOCK VALVES

NEW

"FLOCONTROL"
TYPE 5525 — 600# GLOBE
TYPE 5535 — 600# ANGLE
RENEWABLE HARD-FACED STAINLESS STEEL SEATS
"500 Brinell" Stainless Steel V-Port Discs.



For general industrial service. Variable orifice, shut-off and index combined in a single valve. Any desired setting can be instantly duplicated. **Sizes:** ¼" thru 2". **Standard Materials:** Forged carbon steel. **Connections:** Screwed, Socket Weld and Flanged Ends. **Screwed and Socket Weld Valves:** For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. **Flanged Valves:** For all pressures up to 600 psi at 850°F. O.W.G. — 1440 psi at 100°F.

NEW

HI-PRESSURE DROP
TYPE 5505 — 600# ANGLE
INTEGRAL HARD-FACED SEATS
Stainless Steel Tube.

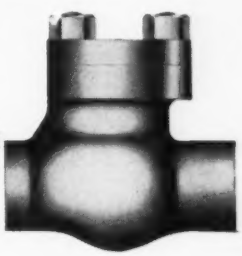
An orifice type valve, with shut-off and index in a single unit that permits the use of a smaller valve with a large capacity. Designed to withstand the terrific wrecking power of continuous blow-down. Also for use on feed-water, by-pass relief, in turbine washing processes, and where erosion is extremely severe. **Size:** 1". **Standard Materials:** Forged carbon steel. **Connections:** Screwed and Socket Weld Ends. For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. A.S.M.E. maximum boiler pressure 970 psi.

factured. You can be sure of long resistance to wire drawing, galling, steam cutting, erosion and corrosion — for leakproof tightness month after month. They surpass the toughest service demands of process and power piping systems in the most modern refineries, petrochemical, power and industrial plants. A high degree of standardization in all sizes simplifies both maintenance and inventory needs.

Let the durability, performance and economy of Hancock 600# Steel Valves save money for you. Whether you are adding facilities, building a new plant or setting up a revalving program, get all the reasons why these tough valves serve better and longer. Complete information is yours on request.

NEW

LIFT CHECK VALVE
TYPE 5540 — 600# GLOBE
RENEWABLE HARD-FACED STAINLESS STEEL SEATS
"500 Brinell" Stainless Steel Piston Discs.



For general industrial service. **Sizes:** ¼" thru 2". **Standard Materials:** Forged carbon steel. **Cap:** Bolted. **Connections:** Screwed, Socket Weld and Flanged Ends. **Screwed and Socket Weld Valves:** For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. **Flanged Valves:** For all pressures up to 600 psi at 850°F. O.W.G. — 1440 psi at 100°F.

When Hancocks go in, valve costs go down

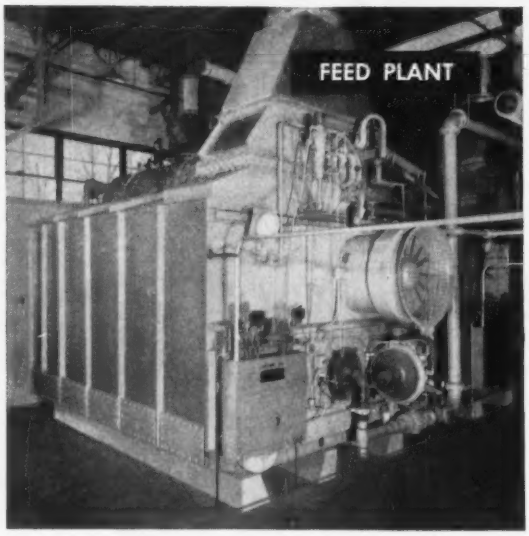
A PRODUCT OF MANNING, MAXWELL & MOORE, INC.

WATERTOWN 72, MASSACHUSETTS

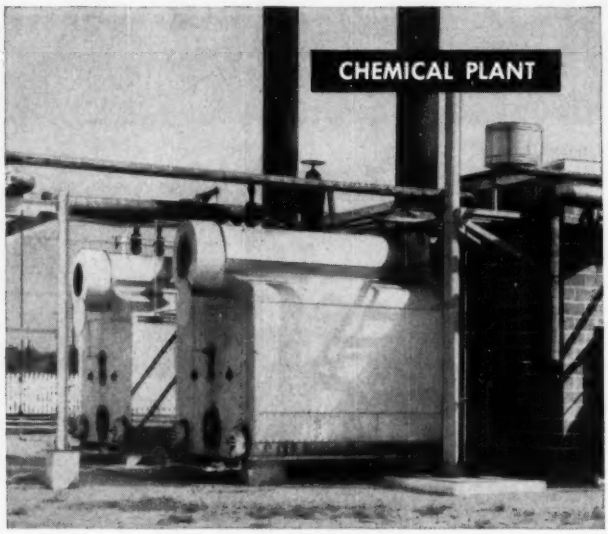
MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, California.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Michigan.*

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

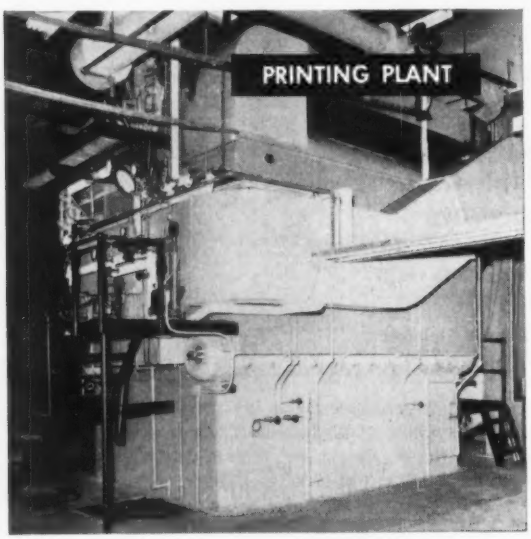
Here's how industries are profiting



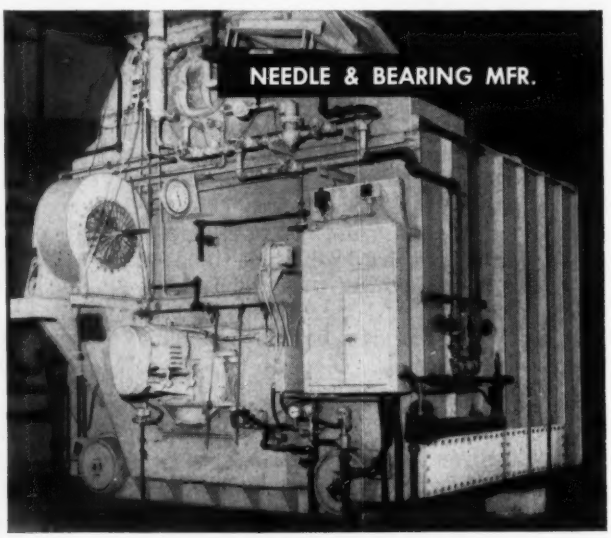
PROVED "DEPENDABLE" IN MODERN FEED PLANT
Playing a dual role in the manufacture of livestock and poultry feed, this is one of two Union Type MH Steam Generators producing steam for processing milk by-products and for providing space heat. Selected "on the basis of good design" by Consolidated Products Co. for its Springfield, Mo. plant, these 22,000 lb./hr. packaged units are reported to "have proven very satisfactory and dependable sources of steam."



"EFFICIENCY HIGH" ON OUTDOOR ASSIGNMENT
That's what Davison Chemical Company, Division of W.R. Grace & Co., has to say about these two Union Type MH Steam Generators. Delivering process steam, this pair of 18,000 lb./hr. packaged boilers handles an important job in Davison's large Lake Charles, La. plant which is equipped to produce approximately 45,000,000 lbs. of petroleum cracking catalysts annually. Selected because of "reputation . . . and delivery," both of the units were shop-assembled in Erie, Pa. before delivery to the job site.

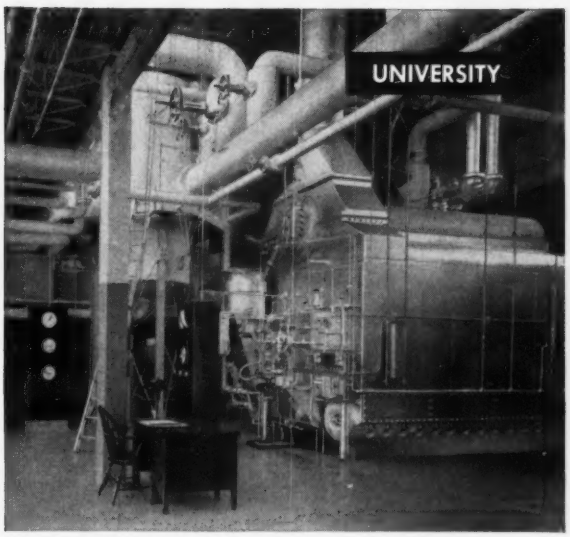


PACKAGED AIR HEATER ADDED FOR 85.79% EFFICIENCY
Here's one of the many ways Union can supply auxiliary equipment with a completely shop-assembled MH Steam Generator to handle special needs formerly requiring costly field erection and special engineering. Serving Western Printing and Lithography Co., this 20,000 lb./hr. unit "has proven very satisfactory." Western also adds, "It was sold to operate at 85% efficiency and is doing that."



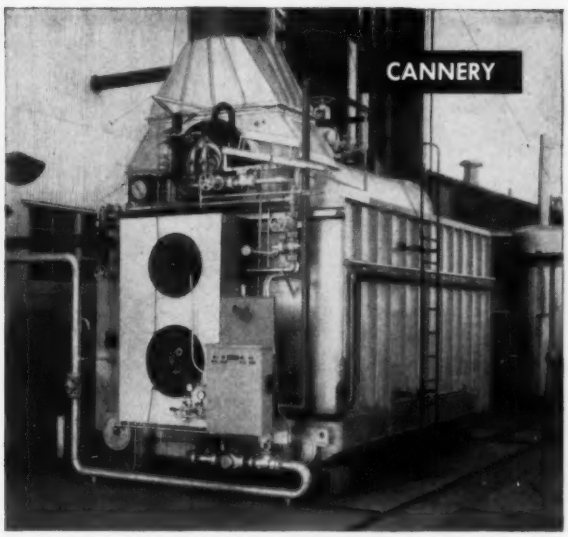
20,000 LB./HR. "MH" SAVES $12,500 IN YEAR
Because "construction and design appeared better than others and physical size fit into plant," a 20,000 lb./hr. Union Type MH Steam Generator was installed in the Excelsior plant of The Torrington Company in October, 1955. In short order, the new boiler proved its worth. When a second MH (15,000 lbs./hr.) was installed in October 1956, Torrington said this about the first: "Estimated savings for the first year are $12,500, as compared to our old coal burning hand fired boilers."

with Union Packaged Boilers



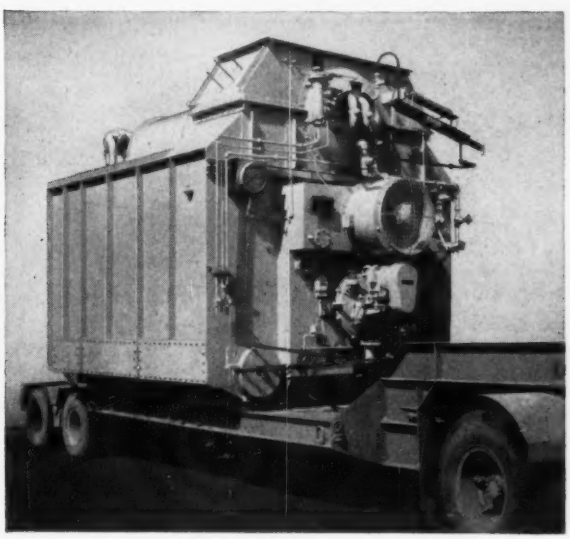
SCORE "BETTER THAN 80%" ON EFFICIENCY TESTS

Providing space heat for 14 buildings on University of Toledo's 170-acre campus, two 28,000 lb./hr. Union Type MH Steam Generators also take part in the educational process. Utilized for laboratory work by mechanical engineering students, these Union Packaged Boilers are reported to operate at "better than 80% efficiency." Says the University, "We get 128 lbs. of steam per gallon of fuel oil as compared to 93 lbs. per gallon with the old boilers formerly used."



ONE "MH" LEADS TO ANOTHER

Tri-Valley Packing Assoc. uses a pair of Union 30,000 lb./hr. Packaged Steam Generators. In 1953, Tri-Valley's first MH Unit went to work in the Association's Modesto plant. When the San Jose plant needed a new boiler in 1955, another Union Packaged Boiler (shown above) was picked for the job. Says Tri-Valley, "Our selection was based upon our evaluation of the design . . . and the performance of the MH Packaged Boiler installed in our Modesto plant."



ARRIVES READY FOR IMMEDIATE SERVICE

Just position it . . . connect up . . . and light off! It's as simple as that to put a Union MH Packaged Steam Generator to work in your plant. Delivered by rail or truck, it is shipped completely assembled including boiler, trim, steel cased setting, fuel burning equipment, combustion controls, forced draft fan, soot blowers and super-heater (when required).

HOW ABOUT YOU?

Like more facts on Union's popular MH? Full details including cut-away illustrations, tube layouts and dimension tables for all 13 sizes (10,000 thru 60,000 lbs./hr.) can be obtained by requesting Bulletin MH-353.

Get the full story by mailing this coupon

UNION

UNION IRON WORKS
ERIE, PENNSYLVANIA

MAIL your illustrated Bulletin MH-353 to us at once.

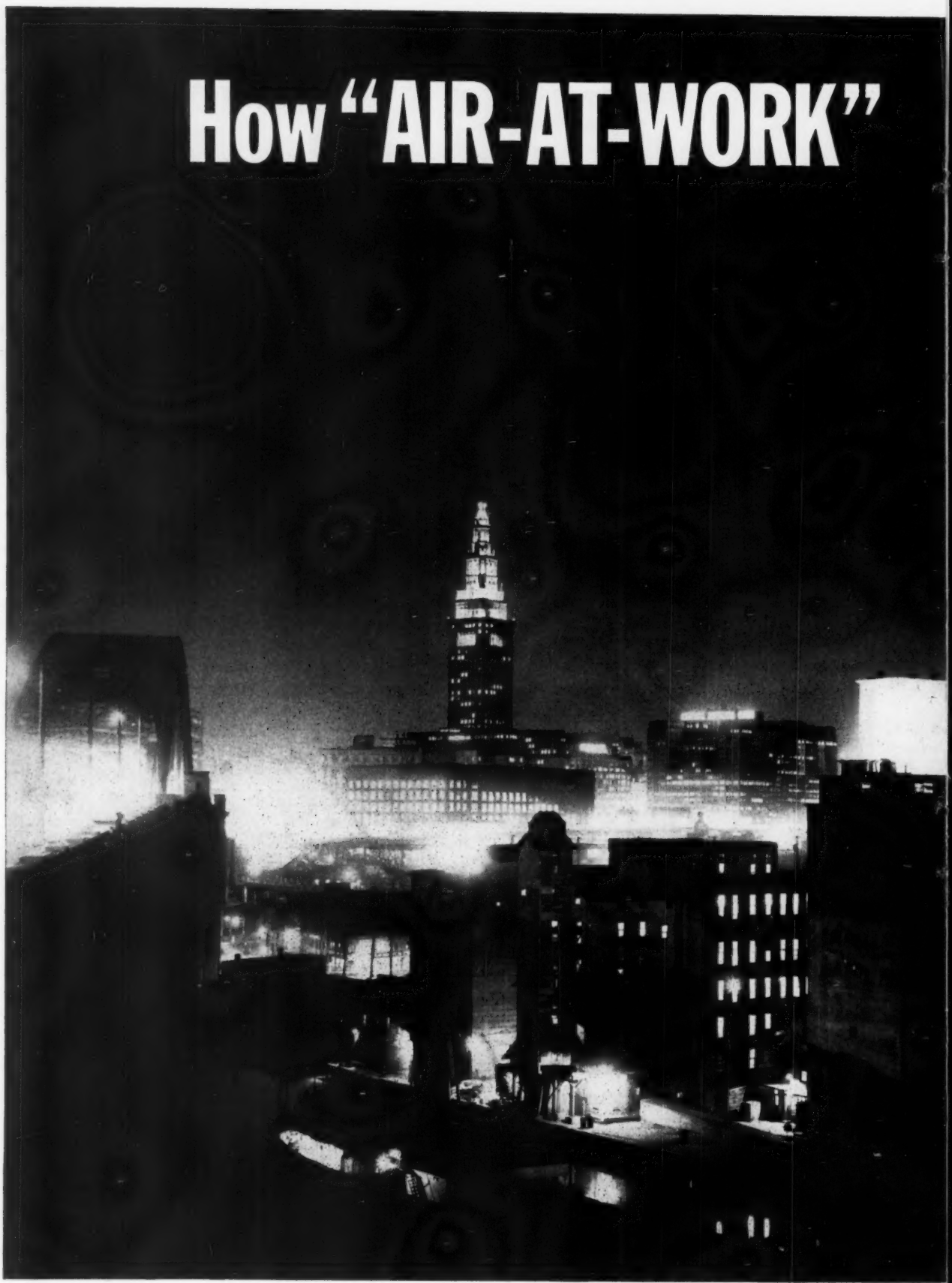
NAME _____ TITLE _____

FIRM _____

STREET _____

CITY _____ STATE _____

How "AIR-AT-WORK"



Helps Light Cleveland

The Cleveland Electric Illuminating Company has used Westinghouse Mechanical Draft Equipment for Over 20 Years

At Cleveland Electric the job of providing combustion air for boilers is handled by Westinghouse Equipment. And in industrial plants, too, Westinghouse fans are often first choice.

The men who specify power plant equipment at leading utilities from coast to coast know that Westinghouse means top efficiency, unexcelled quality, ability to meet extremes of operating conditions—such as high volumes, high pressures, extremes of speed and temperature. Most important, they know that the Westinghouse name on air handling equipment is backed by more than 90 years' experience and leadership in design and manufacture.

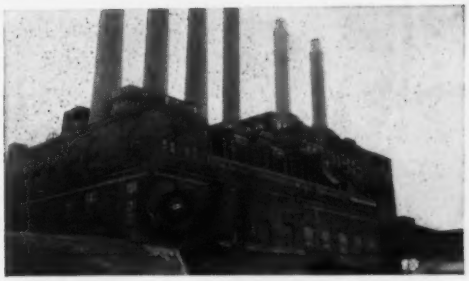
For complete application service, call your nearest Sturtevant Division Sales Engineer. Or write Westinghouse Electric Corporation, Dept. 22E, Hyde Park, Boston **36,** Massachusetts.

WESTINGHOUSE AIR HANDLING

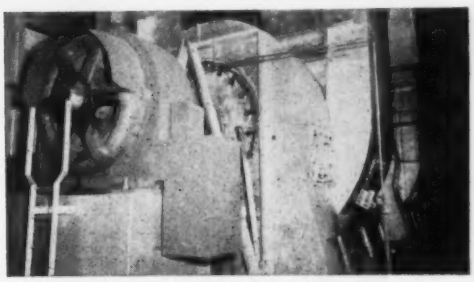
YOU CAN BE SURE...IF IT'S

Westinghouse

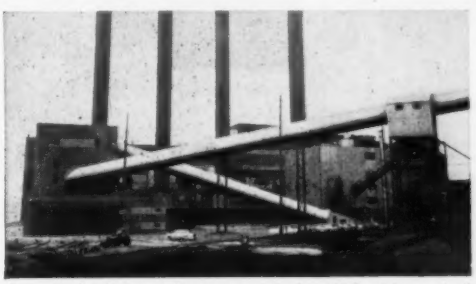
J-80594



Eastlake Power Plant, The Cleveland Electric Illuminating Company, using 16 Westinghouse Heavy Duty Forced and Induced Draft Fans to provide air for 660,000 KW maximum-output generators.

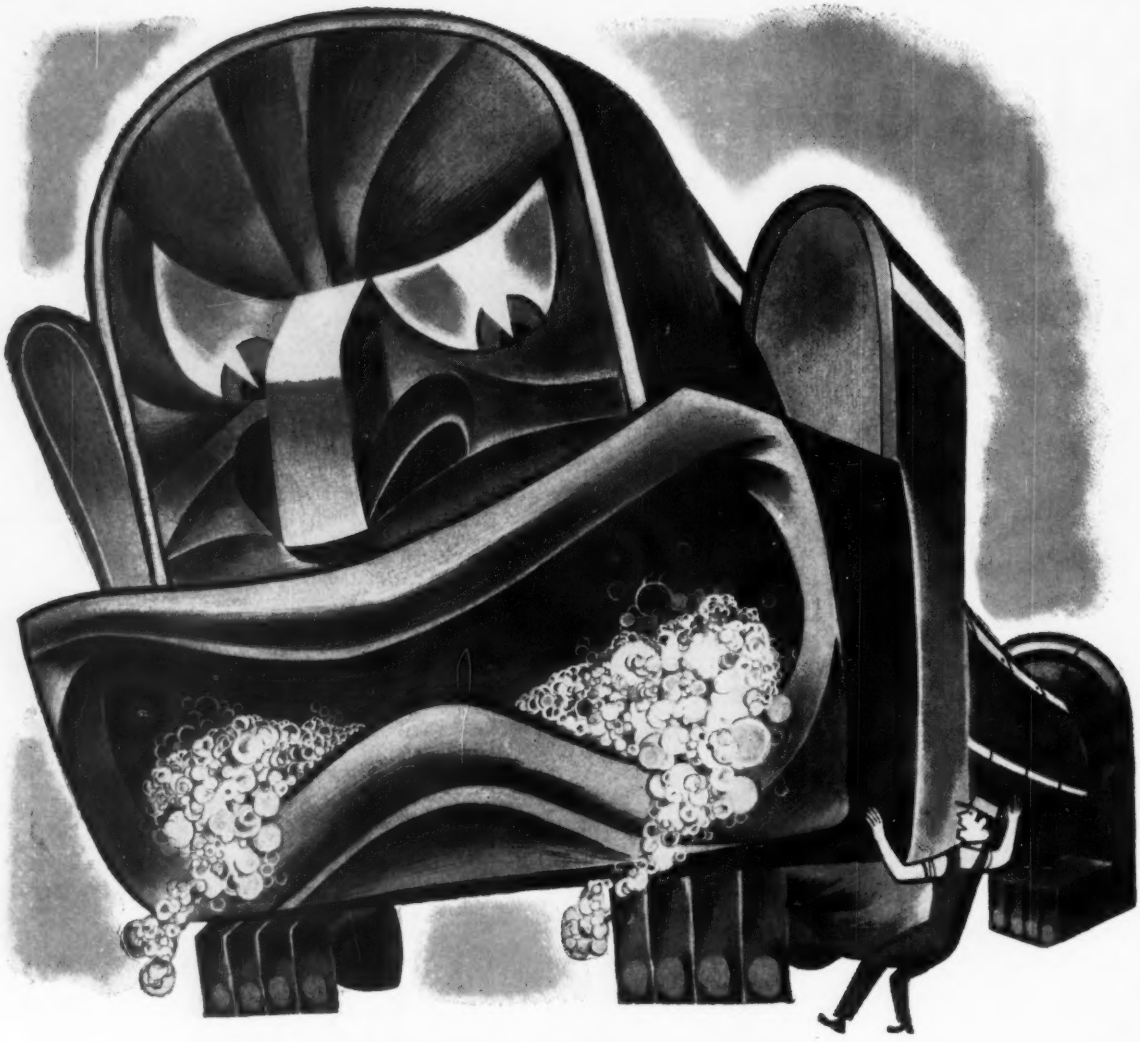


Air At Work – battery of Westinghouse Heavy Duty Induced Draft fans at Eastlake. The fan motors are Westinghouse, too.



Avon Lake Power Plant, Avon Lake, Ohio. Now rated at 420,000 KW capacity, current expansion program will boost output to maximum 670,000 KW, requiring 4 more Westinghouse fans for a total of 10 FD and ID units.

Inside Avon Lake Plant, these Westinghouse Heavy Duty Induced Draft Fans are typical of Westinghouse installations throughout the Cleveland Electric system.



Danger: Foaming Turbine!

Time for Cities Service Pacemaker-T Oil

No question about it—a foaming turbine lubricant means danger!

Foaming hampers hydraulic governors and other control mechanisms that depend on the non-compressibility of an oil for proper operation.

Generally, it's not the turbine but the lubricant itself that's to blame.

For only a lubricant with the finest anti-foam additives—a lubricant such as Cities Service Pacemaker-T—can withstand constant churning.

Equally important to flawless operation are the other qualities of Cities Service Pacemaker-T Oils: superior oxidation and rust resistance, excellent water separating qualities, and proper viscosity.

If you'd like a more efficient operation—or want to know what type of lubricant is best for you—call in a Cities Service Lubrication Engineer. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

Revolution— American style

QUIETLY, without fanfare, the U.S. passed a milestone last year that marks a major turning point in a revolution long in progress. Sharp-eyed specialists noted it, a few perceptive newsmen reported it, but in spite of its far-reaching importance it made less public stir than a Mickey Mantle homer.

What was the milestone? Simply this: For the first time in this country—or any country—the number of people producing goods was fewer than the number providing services of all kinds. And this statistical milepost was passed at a time when the physical production of goods was at an all-time high.

Clearly this doesn't mean that we have, as a nation, developed a preference for services in place of goods. It does mean that we have learned to produce more and more goods with fewer and fewer people. This, in turn, gives us the income to buy more and more services, and releases from production the people needed to provide an increasing variety of services.

In this typically American revolution, power has been a root cause. Only when low-cost energy is abundantly available is it possible to mechanize industry. And only by mechanization can we take the big strides in productivity that make it possible for less people to turn out more goods in fewer working hours.

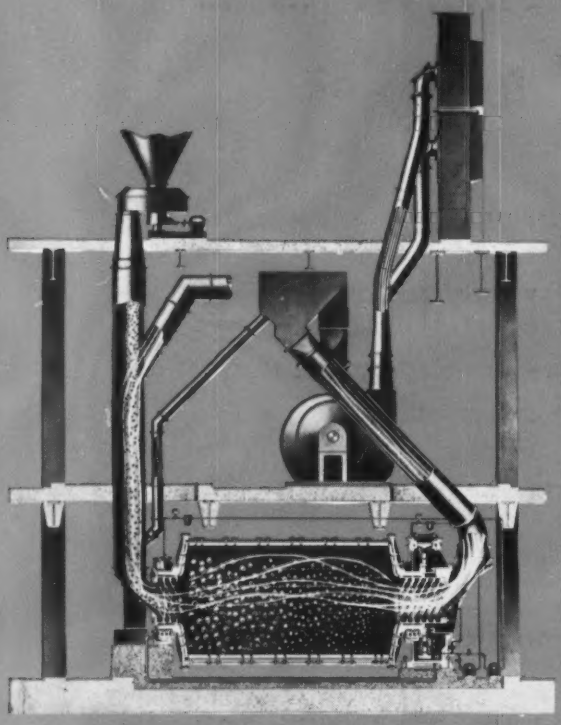
Precise figures on the role of energy in the development of industry are hard to come by, particularly for periods far enough back to permit us to measure our progress. The following rough figures will serve, however, to gage what has happened. One hundred years ago, about two-thirds of all U.S. work was done by muscle power—human and animal. Today, these energy sources account for only a few percent of the total work—the overwhelming proportion is now done by energy from inanimate sources.

Not only have we power men made vastly greater quantities of energy available to supplant the puny efforts of men and animals, we have made energy available at ever increasing efficiency. As a matter of fact, we have increased the "productivity" of inanimate energy sources faster than our manufacturing friends have been able to increase the productivity of the working force.

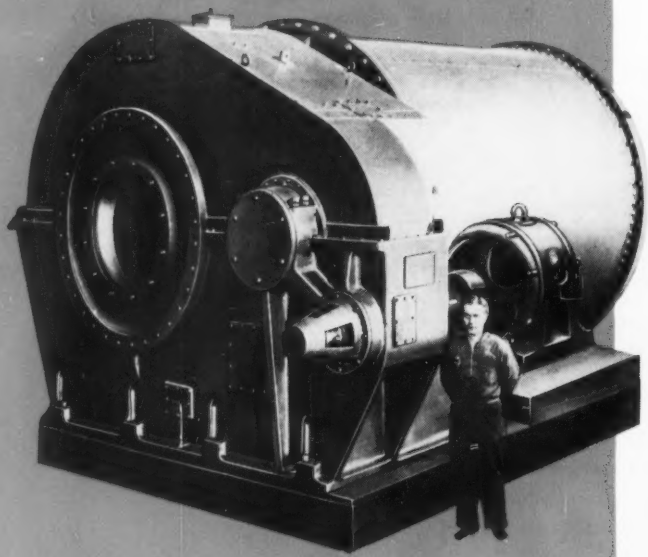
These accomplishments are cause for solid satisfaction. But they're only a patch on the job ahead. To an ever greater degree, energy will be the basis for future physical progress. In the dynamic world of tomorrow, providing that energy will take every ounce of skill and vision we can command. For power men, the years to come hold nothing but new challenges—and what's wrong with that?

KENNEDY

money makers! money savers!



COAL FIRING SYSTEM. Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.



AIR SWEPT TUBE MILL. Slow-speed ball mill for perfect pulverization by air separation. Low-cost grinding of all grades of coal regardless of hardness. Grinding balls can be added without shutting down. Continuous year-to-year operation with better than 99% availability. Complete designs for steam and coal installations.

K.V.S. SYSTEM INCLUDES THESE EXCLUSIVE FEATURES

UNBURNT CARBON LOSSES LESS THAN ½%.

- FULLY AIR SWEPT
- COAL PULVERIZED TO SUPERFINENESS
- COAL COMPLETELY CARBURETED Ready for Combustion
- BIG TRUNNIONS FOR AIR SWEEPING
- BALLS ADDED WITHOUT SHUTTING DOWN
- LOW OPERATING AND MAINTENANCE COSTS
- 85% TO 90% THROUGH 200 MESH
- 20% MOISTURE REMOVED WHILE PULVERIZING
- PULVERIZES ANY COAL—BITUMINOUS, ANTHRACITE, FLUID COKE
- TRAMP IRON ACTUALLY AIDS IN PULVERIZING

consider these advantages

KENNEDY

PULVERIZERS

Kennedy Pulverized Coal Firing System Saves Over $3.00 Per Ton on Coal!

saves...

In utilizing low priced coals

In low cost maintenance

In producing superfine coal for fast combustion

In availability ... over 99%

In increased efficiency

In maintaining a clean furnace

In reducing losses out the smoke stack

ARE YOU PROFITING FROM ALL THESE ADVANTAGES?

then...decide for yourself

Large boilers should have fewer and better pulverizers. There is no reason for using more than two mills per boiler.

If your boiler burns coal at the rate of 100 tons per hour, you can pulverize this coal ... any grade ... with only two KVS Mills. Why use four when two will do?

Don't accept a "second best" system with high maintenance costs. Insist on a KVS Pulverized Coal Firing System for your boiler — either present or future — and gain the advantages of over-all lower maintenance costs.

Get the facts — then make your choice.

-VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

TWO PARK AVENUE, NEW YORK 16, N. Y. • FACTORY, DANVILLE, PENNSYLVANIA

TESTING and INSPECTION at Pittsburgh Piping

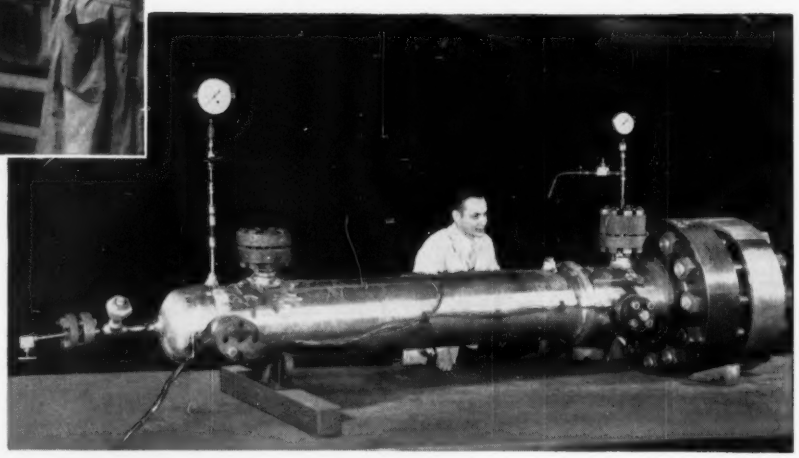
Fluorescent-penetrant examination detects surface defects. Pipe exterior is painted with fluorescent-fluid, then dusted with powder which draws fluid to surface where it is observed under ultra-violet light.

another
P. P. & E. service
which contributes to
Improved
HIGH-TEMPERATURE HIGH-PRESSURE PIPING

Fabricated chrome-moly header for central station piping system.

This testing instrument transmits ultra-sonic waves into pipe wall, with their movement around the pipe being indicated as a consistent pattern on the instrument's screen. Any internal defect in the pipe wall reflects the waves back to the instrument more quickly and is thereby revealed on the screen.

Close quality control is maintained throughout the fabricating process at Pittsburgh Piping by means of almost a score of different types of tests and examinations — three of which are shown on this page. Our technical staff supervises these procedures — checks all materials and production operations. This activity assures that each component, assembly, and the final piping system fabricated and erected by Pittsburgh Piping meets code and insurance requirements . . . fills the customer's specifications . . . and gives trouble-free service.



Hydrostatic testing at Pittsburgh Piping. This stainless steel surge tank is being tested at pressure up to 5,600 psi. Strain gauges are used to check closely for plastic deformation.

PRODUCTS AND SERVICES

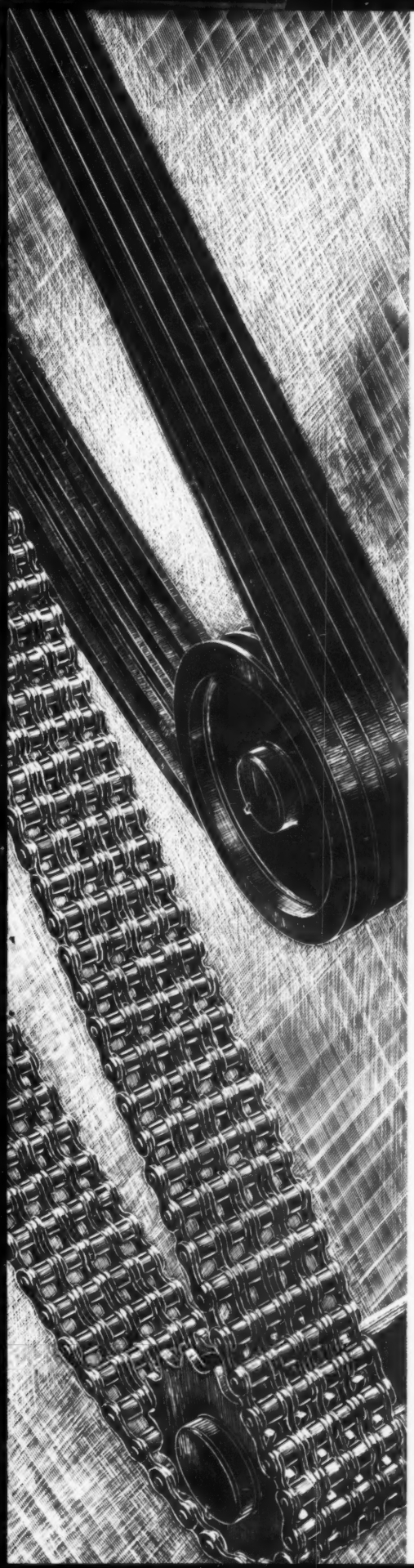
Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

PP-23

Pittsburgh Piping
AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

OFFICES IN PRINCIPAL CITIES

Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Hollywood	1828 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street



Belts and Chains

By ALTHEA THORNTON, Assistant Editor

The link between driving unit and driven load is often considered too casually on both the design and operating level. Where this link is a belt or chain there are several practical approaches to selection that should be taken into account after studying the types of belts and chains on tap.

Probably the most common oversight in applying belts and chains is that of overlooking the bald fact that all horsepower transmitted between driver and driven unit goes through the belt or chain. This fundamental thought, coupled with the fact that many new belt materials are now available, should broaden the horizon for every power-service engineer facing up to the job of selecting and maintaining belts and chains.

Because of their continuing importance as a power-transmitting medium, POWER prepared this 20-page special report outlining current trends, materials used, design features, plus selection, application and maintenance information on both belts and chains. In the belt classification are both flat and V-belts, plus the newer ribbed and toothed designs. In the chain section emphasis is placed on roller and silent chains as main elements in use for power transmission where a flexible, yet positive, drive is needed.

In this strictly practical treatment the effort throughout is to give you—the power-service engineer—the information you need to select, install and operate belts and chains successfully; an understanding of the job a belt or chain must handle, the types available and the steps involved in determining size. Use this special report to help turn your plant into a smoother trouble-free operation.

A Power special report
May 1957

Belts and chains bid for future

Along with many other machine elements, the trend in belts and chains is to smaller, more compact drives that can transmit more power at higher speeds. This is evidenced by recent developments like the toothed and ribbed belts, p 85, the higher capacity "premium" quality V-belts, reratings of standard V-belts to higher capacities. Development of improved materials, heat treatment and manufacturing methods for chains, plus a special high-speed high-hp chain points to the same trend.

BELTS: New materials, new constructions

The fact that V-belts are available, standardized, economical, durable, pre-engineered and convenient to install has contributed greatly to their increased use in recent years. Equipment manufacturers will continue to find more use for them as improved materials make them more compact, more resistant to heat, oil, high temperatures and aging.

One manufacturer estimates that by 1960, rayon, spun rayon and nylon will replace cotton as a jacket material on premium rubber flat and V-belts. These materials are stronger, have better resistance to breaks, offer better flexing and heat resistance and have higher tensile strength.

New weaves will probably be used to further improve belt quality. Heat-resistant synthetic rubber will also be used more widely.

Most standard V-belts are now made with rayon-cord strength members. High-capacity belts are generally made with rayon-, nylon- or dacron-cord strength members. Steel wire is also used. Although it doesn't stretch, it's not as resilient as fabric cords. Result: Belts require better sheave alignment.

A high percentage of synthetic rubber is used in standard V-belts. Neoprene, because it is heat- and oil-resistant and has unusually good wearing and aging qualities, is often used in high-capacity belts.

Another probability: By 1960 there will be a significant increase in the number of special V-belts available.

Further into the future: Belt-drive engineering will improve beyond the extent now visualized. Designers will be able to furnish belts to more exact specifications when required.

All belt drives, including the new ribbed and

CHAINS: Dimensional control and improved

Chains are a staple item used widely in the power-transmission field. Their growth has matched economic conditions, and probably will continue to do so for many years to come.

Chains have been employed in one form or another for 2000 years. But modern chains have had their big growth since about 1864. The forerunner of modern roller chain was developed in England in 1864; a detachable chain was patented in the U.S. in 1874; a bushed roller chain was built in 1880. The present-day type of silent chain was first introduced in England in 1895; finished steel roller chain was introduced as a bicycle drive about 1895.

Fundamental design principles of chains have changed little over the years. Instead, improvements have been in better materials, improved lubrication and manufacturing methods. Standardization has played a major role in making the modern chain drive a reliable interchangeable unit.

Manufacturers are constantly on the lookout for a chain having maximum ultimate strength, wear life and fatigue life—yet made from the least costly materials. Improved heat-treatment methods are important in achieving these goals. Controlled atmospheres, times, temperatures during heat-treatment cycles are aimed at producing chain links with uniform characteristics.

Improved dimensional control of pins, bushings, rollers and side plates tends to increase fatigue life. Most manufacturers are devoting considerable research to this problem.

Self-lubricated roller chain, made with sintered steel bushings, is a new answer to the problem of inadequate

with few outward changes

Manufacturers expect sales of V-belts and power-transmission chains to increase gradually over the coming years, about in proportion to the increase of gross national product. Newer elements like the toothed and ribbed belts will find their place, with sales considerably increased over present levels. Flat-belt sales will remain at about the same level as today, reflecting their continued use as replacement items on existing production and power plant equipment.

make higher speeds and ratings possible

toothed constructions, will gradually find their rightful place in the scheme of things.

Changes in the automotive industry, which is increasing hp each year and adding more belt-driven accessories, will require many changes in V-belts. Pulley size is being reduced and operating speeds increased. This will mean further redesign of belts. Improvements made to cope with these needs will be passed on to other industries.

Belt rerating program, recently completed by the Multiple V-Belt Drive & Mechanical Power Transmission Association, reflects the need for accurate knowledge of what belts can do in service.

New ratings take into account that: (1) Longer belts have greater longevity than shorter ones. (2) Both sheaves have an influence on belt life. (3) Improvement in V-belt design and quality over the years allows higher loading. These factors are reflected in new tables.

Premium-quality belts, previously rated at a flat 40% higher capacity than standard belts, are now given separate ratings for more accurate calculations. Some ratings are lower than 40%, others higher.

Industry is planning additional rating tables to help a user pick out a drive for exactly the characteristics he needs. To meet space requirements, for example, he can use fewer belts if sacrifice in belt life is less important.

In the flat-belt field, development of new plastic high-speed low-stretch belts, p 81, is worth watching.

Growth of built-in motors, compact gears, enclosed drives and variable-speed needs presents a challenge to the belt industry. We are in an age of drive refinement, where improved service needs must be met.

heat treatment reduce wear, increase life

chain maintenance. Bushings are impregnated with oil. As chain operates, oil oozes from bushing, covers bearing surfaces. When chain stops, oil is reabsorbed. Manufacturer claims that, where external lubrication is not applied, the self-lubricating chain will outlast standard chain, improve chain efficiency and cut maintenance costs, if used for the recommended horsepower under average shock load conditions.

Other makers use oil slots in roller-chain bushings to allow better lubricant penetration. Prelubrication also helps to increase life when maintenance is neglected.

A high-hp high-speed silent chain, developed in 1951, uses an involute rocker joint and involute sprocket teeth to eliminate chordal action inherent in chain drives. When correctly lubricated and used under proper conditions, this chain has proved a solution to many difficult problems.

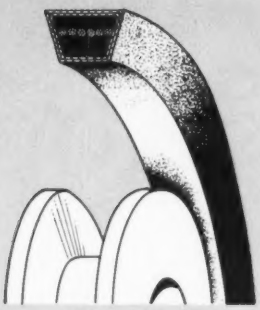
Stainless-steel and bronze chains are available for corrosive conditions, high temperatures. These chains are particularly effective where loss caused by corrosion is more serious than loss through ordinary chain wear. They have lower hp ratings than comparable standard drive chains.

General improvement in materials has also affected chain sprockets. Steel sprockets with cut teeth find many applications. In addition, use of tapered interchangeable bushings on single-strand chain sprockets is helpful to the user. Smaller sprockets are generally bored to size, eliminating cost of special machining operations in the field.

BELTS

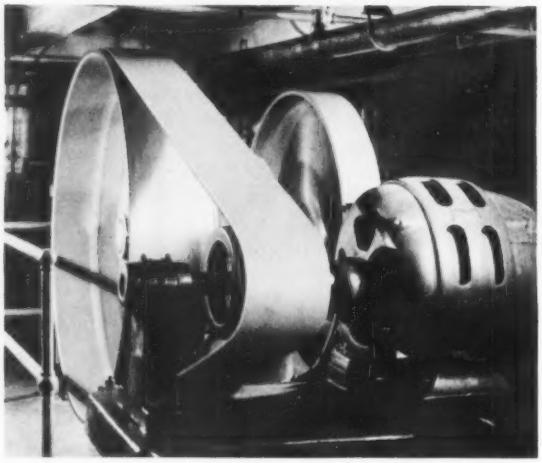
Today's materials, designs give top power-transmission performance

FLAT BELTS transmit power by friction between belt and pulley surfaces. Many materials are used, the most common being leather and rubberized fabric



V-BELTS were originally developed as a refinement on rope drives. They transmit power through wedging action against sides of grooves in the sheaves

FLAT BELTS: Modern constructions



FLAT BELTS can operate on long or short centers, at high or low speeds; are readily adapted if drive conditions change

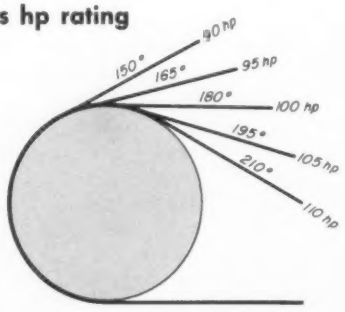
Of the many belt types being used, the flat belt is by far the oldest. It depends on friction to transfer power from driving pulley to belt and in turn from belt to driven pulley.

Materials of both belt and pulley play a big part in determining actual friction between contacting surfaces. Amount of friction is also a function of belt tension, arc of contact, moisture, dirt, grease on contacting surfaces.

Leather, rubberized fabric and cord are widely used as base materials for today's flat transmission belts. Both rubber and leather designs are available in special constructions to resist oil, heat, static and moisture; and to cope with problem of fixed center operation. Keep in mind that moisture, dirt, grease on belt or pulley surfaces cut the coefficient of friction. Lowered friction encourages belt slip that leads in time to excessive wear. Also, oil and grease rots leather and softens rubber, paving the way for fabric cracks and ply separation. Be on the lookout for excessive heat, abrasives, metal particles and corrosive atmospheres.

Arc of contact affects hp rating

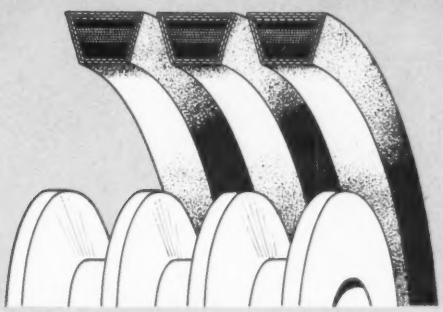
The more wrap or contact a belt has on smaller pulley, the more power it transmits. Apply correction factor from maker's catalog when you figure the capacity of the belt



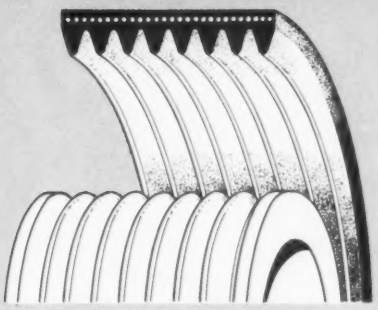
Adjustable motor bases provide tension control for flat and V-belt drives

Proper tension helps belt carry its full load without slipping and burning (too little tension) or overloaded bearings and reduced belt life (too much tension).

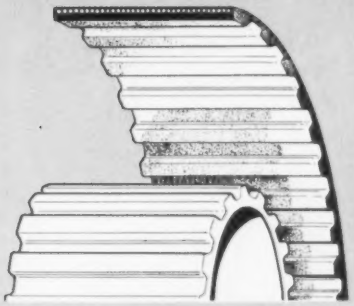
On horizontal drives with long centers and slack on top, unsupported belt weight between pulleys generally maintains adequate tension. Short center, high ratio, inclined and vertical drives usually require an adjustable motor base (right) or a tension-controlling idler. Such idlers may be adjustable-fixed, spring-loaded or free-floating weighted.



MULTIPLE V-BELTS extend the advantages of single V-belts to higher hp drives. Belt lengths and cross sections must be matched to equalize the load



RIBBED BELTS are a recent development. A series of parallel V-ribs is molded lengthwise around the inside circumference of a single rubber belt



TOOTHED BELTS are essentially flat belts with teeth equally spaced on the surface. Belt and pulley teeth mesh to transmit power at positive speed ratios

serve high- and low-speed applications

Adjustable motor bases (panel below) and idler pulleys both come into the picture in controlling belt tension. If possible, steer clear of idlers since they put a reverse bend on the belt. Practically speaking, any belt should be run with the least tension possible to transmit load without slipping. Hold slip, creepage to 2% max.

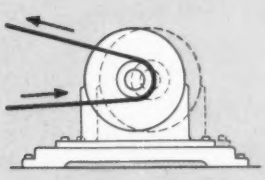
Power transmitting capacity for a given belt increases with speed, up to a point. Capacity increase is related to the fundamental equation incorporating hp, torque and speed. However, on the belt speed curve, a point is reached where the effect of centrifugal force offsets the effect of increasing speed. Immediate result is a reduction in grip between belt and pulleys. Remember, centrifugal force increases as the square of the speed, directly as weight of the belt section. For this reason it's wiser to use a thin wide belt for high speeds rather than a narrow belt with heavy cross section.

Belt selection is influenced by (1) kind of service (2) load characteristics (3) type driving unit and starting method (4) pulley diameters, speeds, face widths (5) distance between pulleys (6) drive arrangement (7) type belt (8) atmospheric conditions. Usually belt capacity is pegged at a value beyond that of the driver. And, a belt with ample capacity for one type load may not do a satisfactory job with the same hp driver under different operating conditions.

Practical approach to selection centers about the hp rating charts in manufacturers' catalogs and application literature. As a rule of thumb it's considered good practice to select a belt as wide as operating conditions permit. Think in terms of increasing belt width for added strength rather than increasing number of plies.

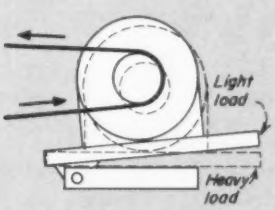
Pulleys are most often made from cast iron, steel, fiber or wood. They are generally designed with a crown, p 81, but may be flat or tapered. Don't depend on flanges to keep belt on pulley.

On pulleys up to and including 7-in. width, the general rule is to select belt 1-in. narrower than the smaller face pulley. On pulleys above 7-in. face, select belts 2-in. narrower than smaller face pulley.



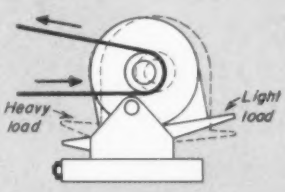
Slide rail

Motor is moved manually to the desired position, then bolted in place. This is the most common of all the adjustable motor bases



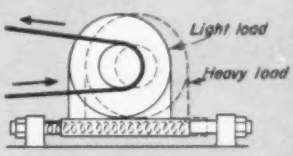
Pivoted base

Weight of motor applies uniform tension to belt. Generally, limits prevent too much movement when the drive is being started



Pivoted cradle

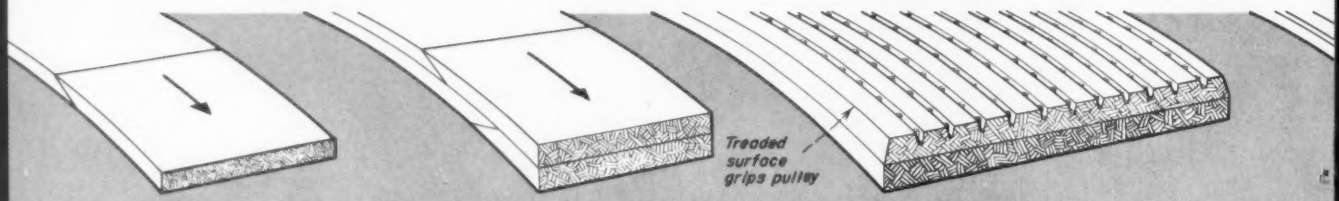
Motor's reaction torque is used to maintain proper belt tension. Direction of rotation affects operation of base; be sure to check



Spring tension

Springs in tension or compression automatically maintain the present belt tension. The motor carriage can slide back and forth

LEATHER BELTS have a long life, boast



SINGLE PLY belt is made by cementing together strips of tanned leather. Note the beveled (scarfed) ends at the joint

DOUBLE PLY is built up from two plies cemented together, flesh side to flesh side. Grain side is always next to pulley

GROOVED LEATHER design has a ribbed surface to increase grip on pulley. Sketch shows double-ply construction

Leather belt is made from the butt end of steer hides (section along both sides of animal's backbone). After tanning, strips of proper width are cut and cemented together for correct length. Belting leather may be vegetable or mineral tanned. Vegetable tanning, which is most prevalent, calls for immersing the hide in a series of liquors extracted from various barks. Chromic acid solution is used in mineral tanning process. Some hides are tanned using both vegetable and mineral processes.

Features of vegetable-tanned belt: (1) Use improves coefficient of friction and pliability. (2) Edges are stiff enough to withstand the action of belt shifters. (3) They are available in single, double and triple ply constructions to match drive hp needs.

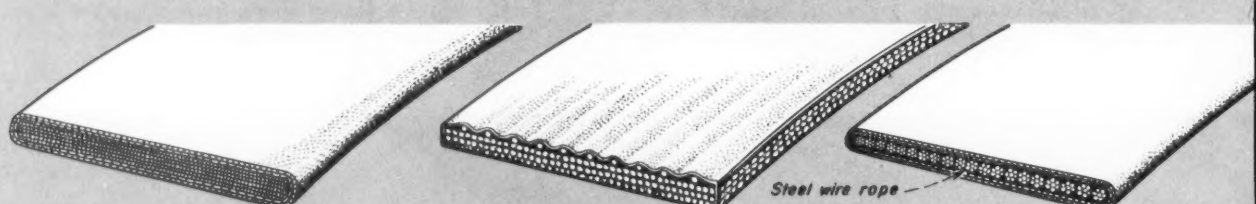
Since mineral-tanned leather boasts greater pliability and larger coefficient of friction than its vegetable-tanned brother, both processes may be combined in one belt. Result: A belt that has an outer ply of vegetable-tanned leather with inner ply mineral or retanned. Or, both processes can be used on the same piece of leather.

RUBBER BELTS cope with specific needs

SQUARE EDGE design uses multiple plies of cotton or synthetic fabric, impregnated and bonded with rubber

FOLDED EDGE type is similar to square-edge belt, but has no raw edges. Used for unfavorable operating conditions

ENDLESS CORD belt has one piece of cord, wound in the neutral axis of belt, surrounded by rubberized fabric cover



MULTIPLE LAYER cord belt is constructed of several cord plies encased in rubber and protected by fabric cover

CORD AND FABRIC type has heavy cords in ridges on top to tighten belt against pulley; fabric plies carry load

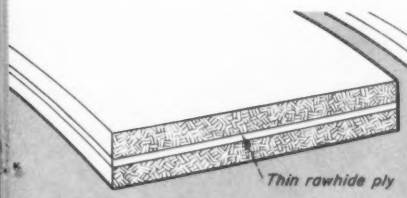
STEEL CABLE belt is made the same as cord belt, but uses endless steel cables to carry load. Used for great strength

Rubber belts are made from fabric or cord, impregnated with natural or synthetic rubber compounds. These give varying degrees of strength, stretch, pulley grip; protect against abrasion, oil, moisture, etc.

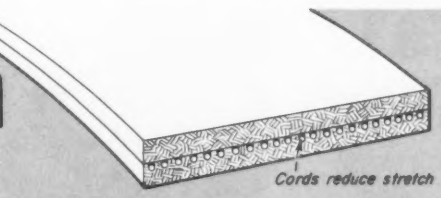
Fabric belts have 3 to 12 plies, depending on width; are used for regular service. Cord belts are generally heavy-duty belts used for high speed, small pulley and shock load drives. Cord materials are cotton or synthetics. Steel cable belts have higher capacity and lower stretch than the cord constructions.

Cord belts are usually supplied endless. Fabric belts may be endless; vulcanized or spliced in the field.

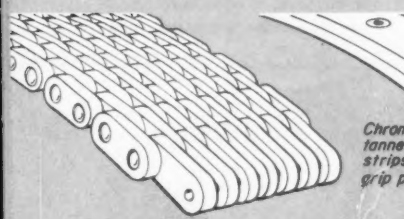
a high friction coefficient



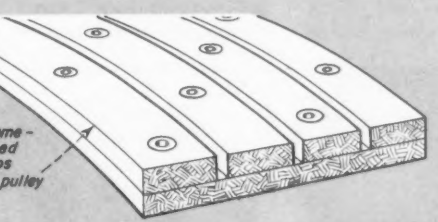
THIN RAWHIDE PLY cemented between two leather plies reduces stretch. Equivalent to a 3-ply belt, but not as thick



CONTINUOUS CORDS are set in the inside ply of belt to reduce stretch. Inner ply is grooved to position cords



LEATHER LINK belt is made of single or two-ply links. Designed for heavy slow-speed drives and high slip applications



COMBINATION BELT, composed of leather or fabric backing with strips of mineral-tanned leather, grips the pulleys

OTHER BELT MATERIALS: plastic, cotton, balata

Majority of flat-belt power-transmission needs are handled with leather or rubber belts. However, there are several other materials available and being used for "specials"—some new, many old.

Plastic belting is a newcomer to the field. A belt made of plastic ply, sandwiched between two chrome-tanned leather sections was recently developed in Europe and is fast becoming available in the U.S. For the same power-transmission rating the plastic belt is thinner, lighter and often ⅓ the width of more conventional leather belting.

Speeds as high as 9000 fpm are considered normal, with test applications running to 20,000 fpm. Even a 90-deg arc of contact can be used. Another feature: Stretch is claimed to be materially lessened. The significant reduction in width makes this belt worth considering for cone drive applications.

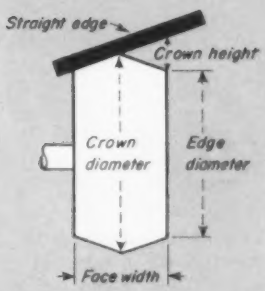
Another high-speed belt, also quite new, uses stretch-resistant synthetic and natural fibers as the base material. Designed to operate over relatively small pulleys without significant internal friction and resultant heating, this belt can run above 100,000 rpm.

Other materials that have served for many years as a prime or secondary ingredient in belting include balata, canvas or cotton duck, metal. Some flat fabric belts are impregnated with balata (a vegetable gum obtained from sap of South American trees). One reason, among many, for using balata, is to provide a high coefficient of friction.

Canvas belting is available in several forms. Some designs are held together by stitching, others by interweaving. In addition there are several hair belts commercially available, generally composed of camels hair interwoven with cotton.

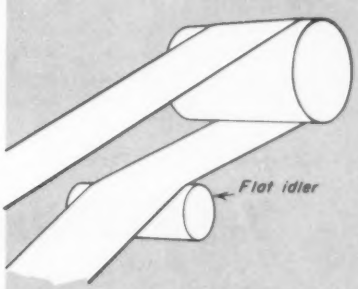
Metal belts are seldom used for power transmission.

Select the right pulley for maximum belt life



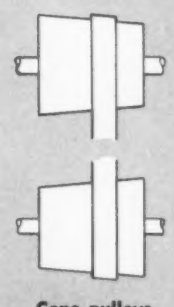
Crowned pulley

Crowning keeps belt centered on pulleys because belt has a tendency to climb to largest diameter. The faster the belt speed, the less crown needed. Maximum is ⅛ inch per foot of pulley face width



Idler pulleys

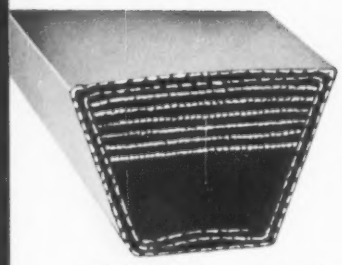
Idlers may (1) increase arc of contact on driver pulley (2) serve as take-up adjustment (3) guide belt in an angle drive. They are flat unless used for guiding; should be as large as practical



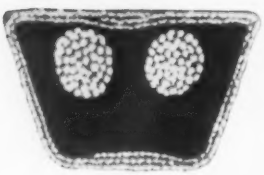
Cone pulleys

Cones often serve to adjust speed. Pulley width should be at least 2½ times belt width. High thickness-to-width ratio, strong edges are needed to withstand strain and edge abuse of this service

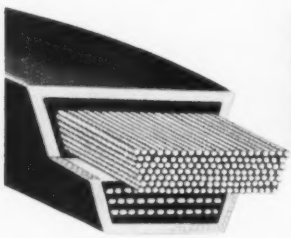
Outside dimensions of V-belts are standardized, but



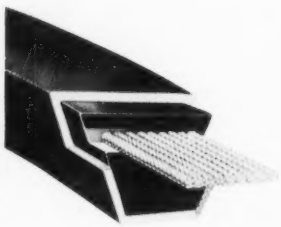
LAMINATED construction has pulling cords in upper part of belt, rubber cushion below



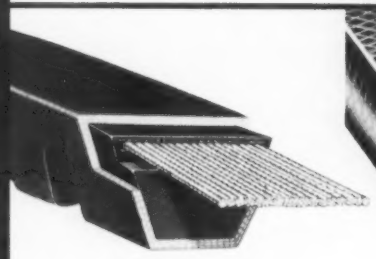
GROMMET belt has endless stretch-resistant cord loops similar to twisted cables



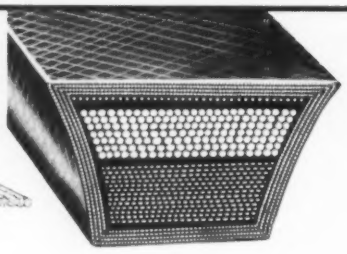
MULTIPLE-PLY belt features endless high-tensile rayon cords, fabric-reinforced base



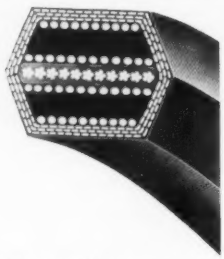
ENDLESS CORDS carry load in this belt. Similar arrangement used for fractional hp



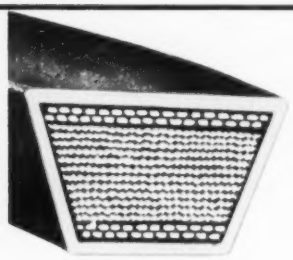
ENDLESS steel cables transmit power in high-speed minimum-stretch notched belt



CONCAVE sidewall belt has cord strength members, rubber and fabric undercore

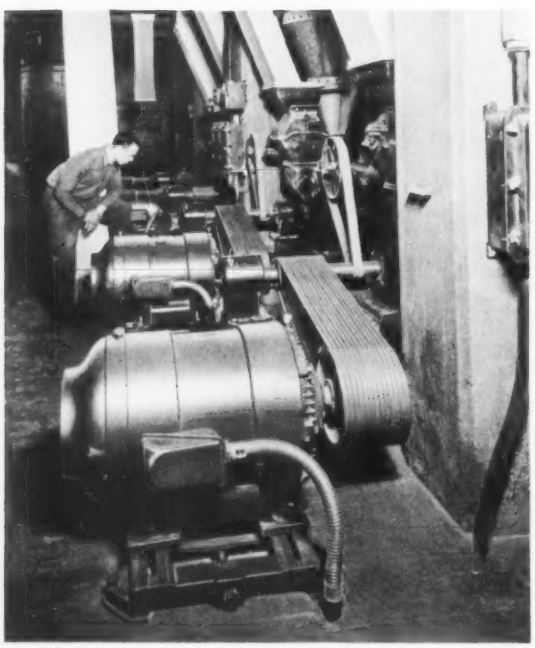


DOUBLE-ANGLE type can transmit power to driven sheaves on both sides of belt



OPEN-END belt is used with metal fasteners; it is built up from many plies of fabric

V-BELT drives feature high wedge grip,



FEED MILL pulverizer drive, above, illustrates V-belt's ability to carry load with minimum attention, over long time periods

Using a wedging action against sides of a sheave groove to transmit power, the V-belt has proven a versatile means for industrial power transmission. Outstanding feature: Greater the pull or load, tighter the belt grips the sheave sidewall. Belts do not touch groove bottoms since this would reduce wedging action. Typical belts are shown in photos, above.

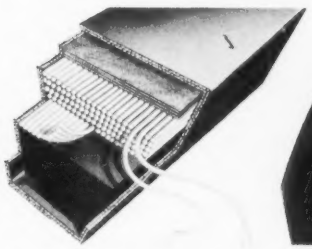
Construction dimensions have been standardized around the five sizes shown on facing page. All belts have a trapezoidal cross-section.

What is a V-belt? Today's accepted definition states that a V-belt "consists of fabric, cord or any combination of these treated with a natural or synthetic rubber compound, and vulcanized in a uniform manner and shape."

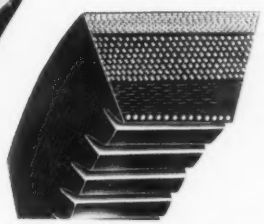
Quality is measured in terms of *standard* and *premium* belts. Latter boasts about 40% more hp per belt for any given size. This classification is built to the same dimensions and is generally recommended for abnormal or extreme drive conditions . . . with substandard sheave diameters, high-speed operation, short center distances, in presence of oil or heat. Premium belts call for fewer individual belts on a multiple drive, fit into smaller space than the standard variety.

Sheaves are grooved to fit a specific V-belt section. There is also a combination sheave specifically grooved to accommodate either *A* or *B* section belts.

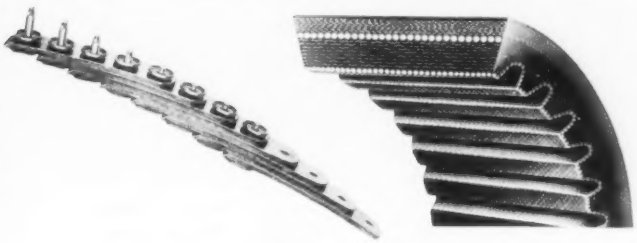
interior constructions vary



LAMINATED CORD construction with two-ply cover. Filler fabric keeps cords parallel



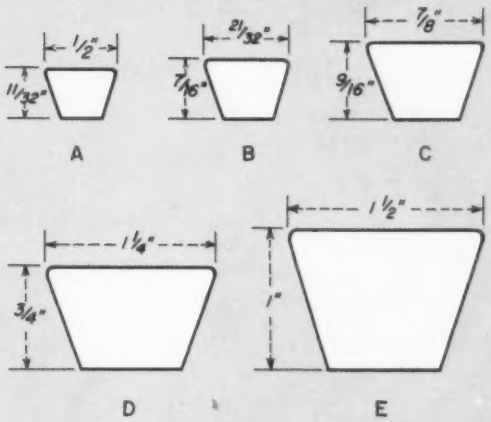
COGGED construction with die-cut raw-edge sides. Cogs maintain crosswise rigidity



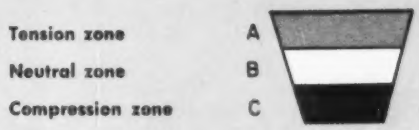
LINK construction makes this rubber-impregnated duck belt adjustable to desired length

WIDE-RANGE variety used for variable-speed applications with variable-pitch sheaves

Standard cross-section dimensions



The belt's three vital zones



positive groove tracking, adaptability

In addition to the standard five sizes, above, right, standardized wide-range belts are available. Designated *Q*, *R*, *S*, *T*, and *W*, they're frequently used with wide-range variable-pitch sheaves. They produce greater speed range although sides of the belt have less contact with the sheave grooved walls. Reason: Allowance is made for greater extreme between minimum and maximum pitch diameters of the variable-pitch sheaves.

Operation of V-belt drives follow this pattern: When V-belt bends around a sheave, its outside zone *A* is in tension; center zone *B* is neutral; inner zone *C* is in compression, sketch above. Neutral zone is the power-transmitting section and also the belt's theoretical pitch line. Load-carrying strength members are in this area.

Pitch length of a belt is a lengthwise measurement taken along the pitch line. Sheave's pitch diameter is diameter of the circle having a circumference that coincides with belt's pitch-line position as it runs in the sheave groove.

Applications include single or multiple installations. Multiple V-belt drives have two or more parallel belts working together, each transmitting a share of the load. "Match" belt lengths to assure equalization of the load among all belts on the drive. In general, before using more than ten belts on a single drive, consider redesigning for the next larger belt section.

Practical belt-speed limits fall between 1000 and 5000 fpm, with some manufacturers recommending 4500 fpm as the most efficient speed. Belts should not be run faster than 6000 fpm without dynamically balancing sheave to counteract effect of centrifugal force.

Chief advantages claimed for V-belt drives: They (1) provide a cushion between driver and driven machines (2) can be used on large speed ratios, short centers (3) are free of vibration, noise (4) slip when heavily overloaded (5) need no lubrication.

Several drives may work equally well on a given drive. Examine each workable setup for economy of operation and individual characteristics before making final selection. A quick review of drive-selection information is presented on the following page.

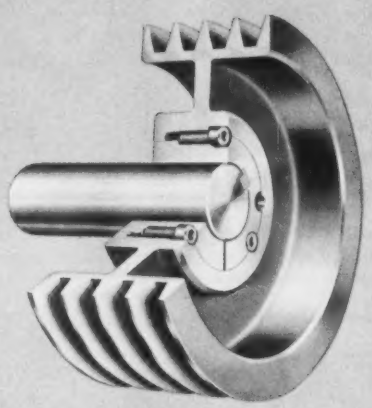
V- and rounded-leather belts

LEATHER V-belt sizes conform to the rubber V-belt sheaves

ROUNDED leather belts are made from ⅛- to ½-in. thick

Sheaves designed for standard multiple V-belts

HUB-AND-SHEAVE combination features one-piece split tapered hub, mated sheave



SHEAVE AND TAPERED bushings are accurately machined for tight fit on shaft

V-belt sheaves are made in standard or deep-groove dimensions to suit varied applications. Several sheaves have detachable and interchangeable bushings to make installation and removal easy, provide for different bore sizes. Two popular types, left, use tapered bushings

SELECTING belts to meet drive needs

Selecting a V-belt for a specific drive generally boils down to thumbing through standard drive-selection tables available in manufacturers' catalogs. Such tables list power each belt will transmit for given speeds and sheave diameters. Ratings are based on an equivalent sheave diameter (d_e) rather than pitch diameter. Equivalent diameter is the small sheave pitch diameter multiplied by a factor determined by the speed ratio. Using this equivalent diameter yields ratings that compensate for combined flexing effect of small and large sheaves.

Pre-engineered drive information is readily available for most V-belt applications. Charts and tables indicate which of the five standard belt cross sections to use, based on design hp and speed of small sheave. Design hp figure is motor hp multiplied by appropriate service factor. Low-hp high-speed drives generally call for small cross sections; high-hp low-speed drives use large cross sections.

Belt hp ratings are also based on 180-deg arc of contact and an average length belt. Ratings are adjusted with correction factors for other lengths and arcs of contact. Dividing design hp by corrected rating for each belt tells you the number of belts needed. Tables also give actual sheave pitch diameters and center distances using standard belt lengths and necessary factors.

Where a pre-engineered drive is not suitable, catalogs give step-by-step information on how to make necessary calculations. Where possible, stick to stock sheave sizes and belt lengths for top economy, ease of replacement.

Basic information in drive selection is an 8-part package: (1) driven machine speed (2) service conditions (3) motor type, hp (4) driver speed (5) driven speed (6) center distance, approximate (7) space limitations (8) diameters and keyways for both shafts. Service factor reflects drive characteristics and nature of load. Also consider the specific operating conditions—frequency of starts and stops, ambient temperature, foreign materials in contact with belt, use of idlers for determining final service factor.

Normal V-V drives, where both driving and driven pulleys are grooved, prove practical for all speed ratios from 1:1 to 10:1. Hold center distances from 1 to 2 times diameter of larger sheave. Although center distances may be as long or short as conditions dictate, short center drives generally yield best results.

Variations of the straight V-belt drive include V-flat (sheave-to-pulley), quarter-turn (sheaves 90-deg displaced), double-V (using an intermediate shaft and sheave arrangement). Where center distances are not adjustable, idlers may be needed.

V-flat drives use one grooved sheave, a flat-surfaced pulley or flywheel, and standard V-belts. This setup, generally found on conversion drives, saves cost of changing existing large pulley to a grooved sheave. V-flat drives are practical where speed ratio is 3:1 or greater and the center distance equals or exceeds flat pulley diameter. Arc of contact on grooved pulley must be about 120 deg. Straight-faced, rather than crowned pulleys, are used. Crowned pulleys would cause tension inequalities between center and outer belts, tending to crowd belts toward top of crown.

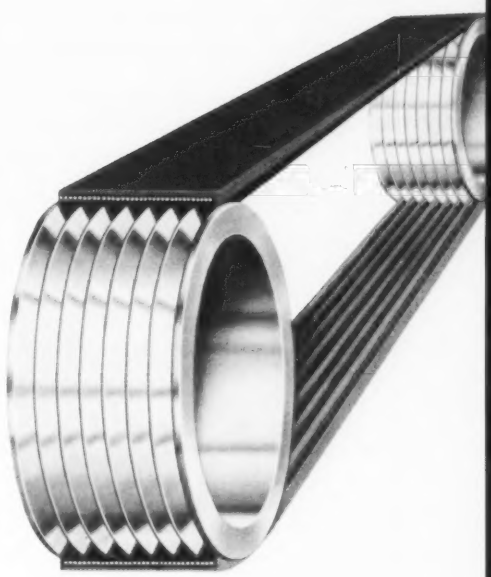
Quarter-turn drives transmit power from vertical to horizontal shaft or vice versa. Such drives use deep-grooved sheaves.

Double-V drives are suited for equipment needing a series of shafts, running in opposite directions, all driven from the same power source.

Where idlers are needed, the V-grooved type running on inside of belt is recommended over the flat type running on belt's backside.

Ribbed belt combines features of both flat and V-belt

- Ribs mate with the sheave for positive tracking
- Strength member is continuous across pulley face



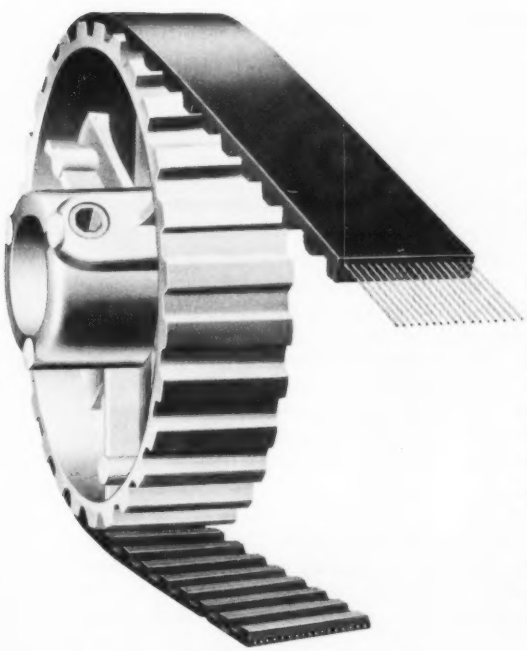
This ribbed belt is an outgrowth of a long search for a belt combining strength and simplicity of a flat belt drive with the high grip and positive groove-tracking of a V-belt. The belt employs the incompressible fluid characteristic of many rubber and rubber-like compounds to distribute pressure evenly over the ribbed driving surface. Belt does not operate by wedge action and drive is designed with the closest possible fit between belt and sheave surfaces.

Grooving provides a traction area about three times that of a flat belt. This large, evenly pressured, total contact traction area becomes a total friction force multiplier, providing high frictional grip per pound of tension on the belt.

These units come in two cross sections: *L*-section belts find application where *A*-, *B*- or *C*-section multiple V-belts would be used; *M* section where *C*, *D* or *E* belts would be applied. Sheaves with tapered bushings are available.

Advantage claimed by the belt makers is less space required since narrower sheaves can deliver equal hp—problem of belt matching is eliminated. Belt is recommended for practically any application where multiple V-belts could be used, often successfully replacing troublesome drives. However, this type belt is not recommended for variable-speed applications or in a V-flat drive arrangement.

Toothed belt, plus grooved pulleys for positive speeds



- Suited for timing drives, power transmission
- Operation is similar to a chain and sprocket

This toothed belt is essentially a flat belt having teeth equally spaced on the surface. It is made with a cable-steel tension member, neoprene body plus neoprene-impregnated fabric facing to provide a wear-resistant surface for the belt's teeth.

Pitch line is the neutral plane in tension member separating both tension and compression zones when belt is flexed. Construction is such that belt's pitch is held constant so it meshes properly with pulleys. When operating, belt and pulley are similar to internal gear and pinion.

Two standard pitches are available: $\frac{3}{8}$-in. for light duty, $\frac{1}{2}$-in. for heavy duty. Stock drives are available off-the-shelf for ratings to 50 hp. But wider belts can extend this figure to 300 hp and above. Special drives can be designed using one grooved and one flat pulley. Speeds to 16,000 fpm and down to inches per minute have been used with the normal operating range between 1500 and 5000 fpm.

Pulleys for average drives are cast iron or steel. Other materials are on tap for special conditions. Standard belts of this type are highly oil resistant. However, special constructions are available for extreme oil conditions, temperatures below —35F or above 180F.

INSTALLATION and maintenance: Pulley

In most installations, misalignment, improper tension, mechanical interference are the chief causes of trouble. Any one of the three will play hob with a belt drive. Here's a rundown on the problems they pose and how to correct them.

Misalignment stands out as the biggest reason for belt trouble. It can stretch a belt unevenly or make it run off the pulleys, cause excessive wear and early failure of V-belts. This problem can be side-stepped by correct alignment initially with periodic follow-ups.

Fundamentals of alignment are: (1) Check shafts with a spirit level. (2) Test for parallel shafts by measuring the distance between them at several points. (3) Run a straightedge between pulley faces, see p 94. Turn each pulley a half revolution, checking whether contact with straightedge is disturbed. If inner rim pulls away on either pulley, shaft is bent or pulley is wobbly. Where drive is already installed, sighting along belts from one pulley to another tells the tale.

Tension is a major factor in belt life. Adjust for

FLAT BELTS

There has been no significant change in flat-belt maintenance techniques in recent years. Except for the matter of belt dressing and differences in methods of splicing leather and vulcanizing rubber, flat-belt maintenance is the same regardless of specific belt materials.

Of course, all flat belts must be installed with care on well-aligned pulleys. Forcing an endless belt over pulleys can stretch it. Best bet is to shorten center distance, then retighten. Barring this, most flat belts can be fastened, spliced or vulcanized on the job.

When ordering endless belts from a distributor, specify length so belts can be eased onto pulleys without damage. After installing, belts should be tightened enough to provide correct operating tension without using all the take-up allowance. Metal fasteners are also used to make a belt endless and insure proper tension. Fasteners, available in many sizes and shapes, are relatively inexpensive, easy to install, require minimum equipment to apply. Service life varies widely with specific design, make, size as related to belt speed, pulley size and operating conditions.

Rawhide thongs are rarely used today as belt lacing, since they have relatively low strength and short operating life. They are sometimes used as a safety link for protecting expensive equipment if a machine accidentally jams.

Maintenance starts with regular check. There are many things to look for during a routine inspection. With leather belts, have your men check for dryness. When pulley faces start polishing, belt needs dressing. Under normal operating conditions, a leather belt needs dressing every 3 to 6 months. Best bet is to use dressing sparingly but frequently. The theory of belt dressing is that it will replace oils normally lost during use or in cleaning. Do not use dressing on rubber belts.

Cleanliness is very important in

V-BELTS

Like all forms of mechanical equipment, V-belt life can be increased considerably by proper installation and sound follow-up maintenance.

During inspection make sure belts ride in sheave grooves so their top surface is just above highest point of sheave. In that position stresses are properly distributed throughout belt section and proper contact is assured. Low riding belt may bottom in groove, relieving wedging action on sheave sides. Result: Belt slips and burns. And when belt rides too high it loses contact area. With deep-groove sheaves, belts run below top of sheaves but should not bottom.

Install V-belts by temporarily shortening center distance, then put belts in grooves by hand. Review tension adjustment after 24-hours and again at 48-hours full operation. Although the gospel of careful installation is being continually preached, mechanics are still guilty of forcing V-belts into grooves with crowbars, wedges, screwdrivers, etc. Trouble here is crude installation techniques may injure the load-carrying cord.

Once installed there are a few simple rules that are wise to adopt. First, never mate new and old belts on the same drive. Unequal load distribution with consequent rapid wear of the new belts may result. Also, use matched belts for multiple V-belt drives. And don't put standard belts on a drive designed for premium belts—you'll cut life.

Belt dressings have their place, but not on V-belts. They tend to soften rubber compounds, temporarily increasing friction at the expense of rapid deterioration. Grit, oil and sunlight are especially hard on V-belts. Keep them clean, free from oil and protected from strong sunlight. Mineral oil is especially destructive as it penetrates the belt, tending to separate cover from the carcass. Where belts cannot be protected from oil,

alignment and tension control are the key factors

just enough tension to transmit load without slipping. Loose belts will slip, lose power and speed, wear rapidly, squeal.

Experienced maintenance men can readily spot a belt that's too slack or too tight just by the way it runs. Briefly, a sloppy slack side indicates too little tension. A simple hand slap test should show V-belts to be alive and springy.

Tension-adjustment devices include adjustable motor bases, p 78, 79, and idler pulleys. Shortening the belt is certainly a practical approach where indicated.

Mechanical interference will cut belt life by actually wearing down material or separating belt plies. Rubbing spots can be picked up by listening for contact noises.

Boiled down, this matter of installation and maintenance of belts is strictly common sense. Have your men apply the simple rules of good craftsmanship and you'll stay clear of trouble—provided *you* selected the right belt for the particular application.

maintaining any belt. Remove any buildup of solids that could damage belt fibers. Oil and grease reduce life and pulling power of a leather belt. In a rubber belt, petroleum products may soften the compound, cause fabric cracking, ply separation. When oil leaks cannot be corrected at source, use oil deflectors. If oil does get on a belt, wipe it off. For any sizable accumulation try a safe cleaning material such as Stoddard's solvent. After cleaning leather belts, apply belt dressing. If proper safety precautions are taken, rubber belts may be cleaned with unleaded gasoline or a 1% solution of trisodium phosphate in water.

use types that are resistant to oil.

High temperatures are also harmful to longevity. So steer clear of any tight-fitting enclosed safety guards that would obstruct ventilation. This same precaution holds for the motor driving the belt as well as the belt itself.

Storage practice plays an important role in belt life. Store belts in a cool dry area, preferably uncoiled. Hang them over wall pegs or on a rack. Remember, if V-belts are left standing under tension on idle equipment they will develop an essentially permanent set that will increase possibility of early belt failure.

Practical pointers on installing...

Ribbed belts

Ribbed belts, described on p 85, are installed much the same as regular V-belts. Sheaves are aligned, then moved closer together so ribs are not harmed when belt is slid into place.

However, correct tension is somewhat greater than for usual multiple-V design. Manufacturer recommends belt be tightened until it is $\frac{1}{16}$-in. longer per foot than before installation. Equalize tension by turning sheaves.

Start drive and apply load. Then, after running a few hours, adjust take-up to compensate for the normal run-in stretching. Best tension indicator is the slack side of belt when drive is carrying peak load. Retighten belt if slack side sags, fluctuates or bulges away from the small sheave.

Drive must be free of, and guarded against, contact with lubricants. Also, check for interference from burrs, turnings, stones and other solid objects.

Toothed belts

Like all other belts, toothed belt drives, described on p 85, should be installed with snug fit; not too tight or too loose. Preloading is unnecessary, may even cause premature failure. Where torque is high, a loose belt may jump teeth on starting. Trick is to gradually increase tension until operation is OK.

Check pulley alignment. Driven pulley may be offset slightly on long center drives. This arrangement conforms to belt's tendency to run against one flange of the driver pulley. Never pry or force a toothed belt over pulley flange. If shortening center distance or removing idler tension does not let belt slide on easily, remove one or both pulleys.

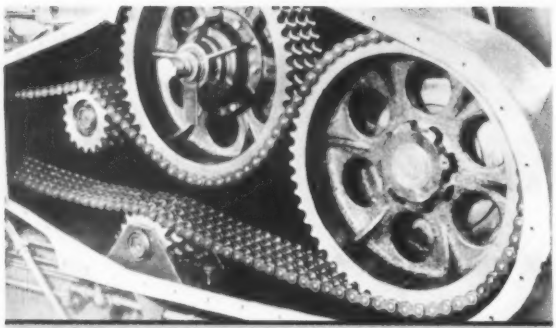
CHAINS: These five types meet mechanical

Standard roller chain

A precision steel chain made up of alternately assembled pin and roller links. Pins articulate inside the bushings while the rollers are free to turn

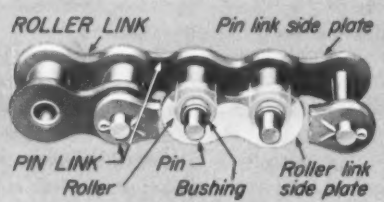
Silent chain

An inverted-tooth precision chain made from parallel leaf links. It is connected by several types of pins and can operate somewhat faster than other chains



Diesel engine application, above, illustrates how the roller chains can synchronize several shaft speeds

Roller chain types



Standard roller chain construction. Bushing area largely determines the power-transmission capacity

Cast roller chain is usually made without any machine finish; therefore it is not a precision chain

Connecting links

Spring clip

Cottered

One pitch offset

Two pitch offset

ROLLER CHAIN

A chain drive consists of two or more sprockets (toothed pulleys) and an endless chain. Sprockets, mounted on parallel shafts, engage links of the chain.

This chain-sprocket combination provides positive speed ratios between drive and driven shafts, without slip. Features: Transmits large hp with relatively small cross section; operates in temperatures impractical for most belt drives; easily installed; made endless to any length; suitable for low and high speeds.

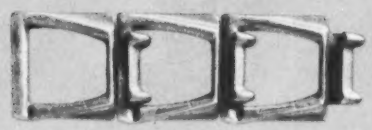
Roller chain is but one of the five types shown above. Standard roller chain, described in ASA Standard B 29.1—1950, is the one most widely used for power transmission. Photo, left, shows standard roller chain construction. There are two basic links: *roller* and *pin*. Roller links have two bushed rollers with bushings press-fitted into two side plates. Rollers can turn freely; bushings cannot turn. Pin links have their pins press-fitted into their own side plates (check photo again for details). When assembled, pins fit through bushings of adjacent roller links.

Advantages of roller chain are (1) wear-resistance between pins and bushings (2) roller's ability to turn when in contact with teeth on perimeter of sprocket.

Standard roller chain, available in single and multiple widths, can handle loads from fractional to several thousands of hp. Multiple strand chain is the equivalent of two, three or more single-strand chains assembled on common pins and having center plates between the rows of roller links. Pitch lengths range from ¼ to 3 in. Operating speeds are generally between 1400 and 2400 fpm with the precise value hinging on number of teeth in smaller sprocket and the chain pitch. Under certain well-specified conditions, roller chain can run at speeds to 4000 fpm; and frequently it is found running at speeds below 500 fpm. Lubrication is essential for effective roller-chain operation. See pages 93, 94.

Double-pitch chain is another variety in the roller family. Similar to the standard chain but with each link

power-transmission requirements of many drives

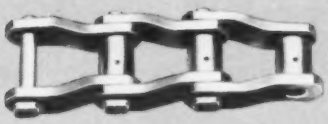


Detachable chain

Made of identical, easily-detachable links that engage with each other. It is available in either malleable iron or pressed steel and used for low speed

Pintle chain

Made of individual open-end cast links joined by steel pins. It operates at slightly higher speeds than detachable chain, often over the same sprockets



Fabricated chain

A wide range of chains made of machine-finished parts alone, or in conjunction with cast or forged parts. Steel side-bar type is popular for transmission

drives are low cost, versatile, widely used

double length, it finds widest application at low hp, low speeds, long center distances.

Heavy-series roller chain, available in pitches ¾ in. and above has heavier link plates than the standard series so can stand higher tensile or shock loads.

Nonstandard roller chains got their start before ASA Standards were adopted. Developed individually by various manufacturers, their construction is similar to standard chains—but they are not made to the same dimensions. Some sizes are still available.

Cast roller chains find application at low speeds, moderate loads, or where precision of standard roller chains is not needed.

Connecting links used to make lengths of standard roller chain endless are shown, bottom p 88. They are similar to pin links, except one side plate is detachable. Spring clip type finds use with chains less than ¾-in. pitch, cottered type with chains ¾-in. pitch and larger. Avoid offset connecting links where possible. They are used, however, when chain with an odd number of links cannot be avoided. The two-pitch type is preferred.

Sprockets are toothed wheels, with teeth shaped to mesh with chain. Cut tooth sprockets, precisely machined, are most suitable for roller chains. ASA Standard specifies dimensions, tolerances and tooth forms.

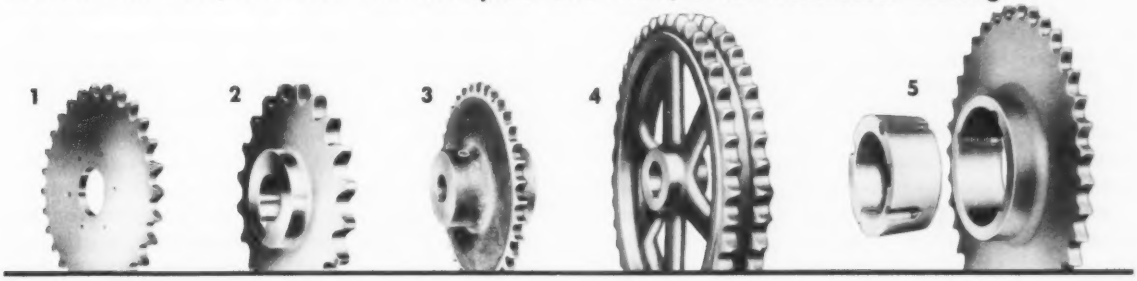
Four sprocket types are available today. Type *A* is a plain plate sprocket without hub. Type *B* has a hub on one side only. Type *C* is equipped with hub on both sides. Type *D*, not shown below, has a detachable hub with a removable rim section for ease in replacement, renewal or change in speed ratio.

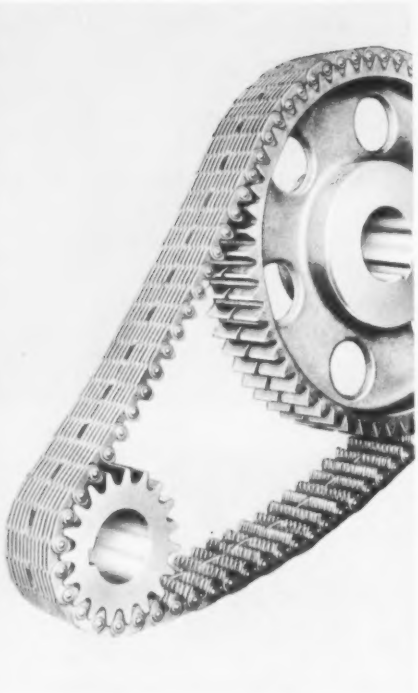
Detachable bushings, similar to those on some V-belt sheaves, can be used with type *B* or *C* hubs.

Between hub and rim the sprocket may be solid, webbed or spoked, according to size. If it must be mounted between bearings, split forms can be used. Shear pin and slip-clutch sprockets prevent accidental damage to drive or driver.

Iron and steel are most commonly used sprocket materials. Where corrosion exposure is significant, use stainless steel or bronze. Formica, nylon and other plastic materials are also on tap for special applications.

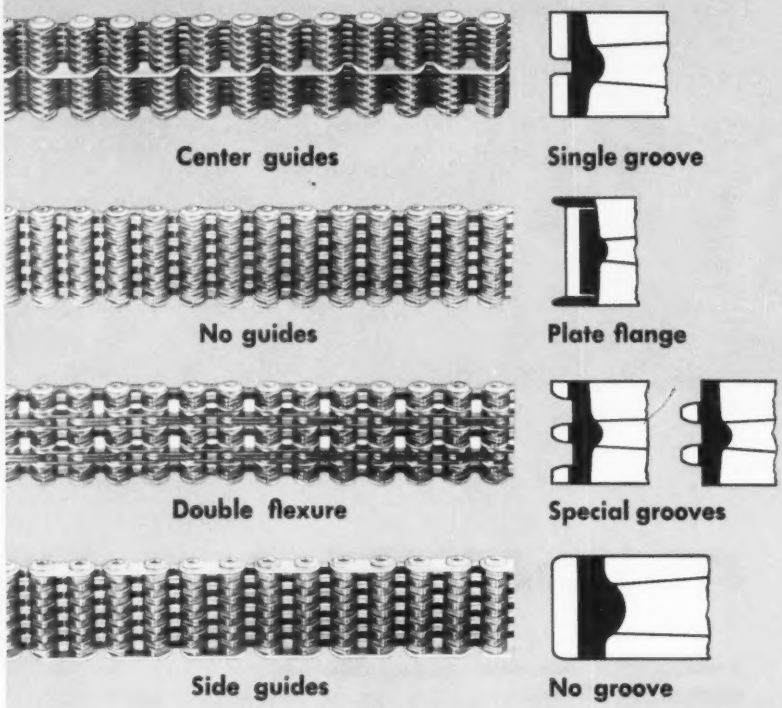
Sprocket constructions vary to suit drive needs. *1* has no hub; *2* has hub on one side only; *3* has hub on both sides; *4* is used with multiple-strand chain; *5* has detachable bushing





SPROCKETS have cut teeth, are similar to those for roller chain except for the tooth forms. Standard silent chain sprocket teeth have straight-line working faces

Chain and sprocket rim constructions



GUIDE PLATES keep silent chain aligned with sprockets. Most chains use one row of center guides; some use two rows. End float or other special conditions may require no-guide construction. Double flexure chains can drive sprockets from either side. Side guides are standard for chains under ¾-in. width

SILENT CHAIN suits many high-speed

One functional difference between roller and silent chain is operating speed—the latter is generally recommended for higher speed. Standard silent chain is designed to run at 1400 to 5000 fpm. A special higher-speed chain, using sprockets with involute teeth, can operate at 6000 fpm continuously, to 7000 fpm intermittently.

Like roller chain, silent chain can transmit from fractional to thousands of hp. Many applications where silent chain is used are within the range served by roller. Since there is a large area of application overlap, consider first cost and operating speed.

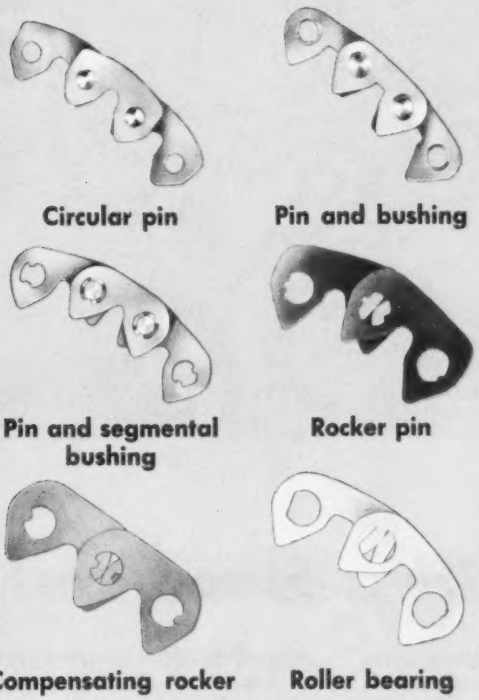
Silent chain is really a flexible form of endless rack connecting two sprockets. It is made up as a series of U-shaped steel links, assembled either with pins or a combination of joint components. When running, chain actually folds into the sprocket teeth. Like roller, silent chain must be properly lubricated for long trouble-free life. Chain is normally run inside an oil-tight casing. Short-center drives can use silent chain to advantage.

Standard chains are described in ASA Standard B 29.2—1950. This Standard primarily provides for interchangeability between the different makers' chains and sprockets. Joint components and link contours vary with each manufacturer since each has a different approach to the problem of getting the best life from chain with minimum maintenance.

With pin joints, sliding motion occurs between pins and bushings. But since bearing surfaces are uniform, wear is evenly distributed. In rocker joints, rolling rather than sliding motion occurs. In general, rocker chain is used for higher speeds, mainly because of its smaller coefficient of friction. See photos, p 91.

Standard pitch lengths range from ⅜ to 2 in. There is also a $^{3}/_{16}$-in. pitch chain for applications where space is at a premium. Chain width greater than 16 times the chain pitch is not recommended. Hp ratings are given per inch of width. Final rating hinges on size

Typical silent chain joints



JOINT COMPONENTS are the distinguishing features of silent chain. They vary with each manufacturer's design. In general, there are two types: *pin joints* with and without bushings, and *rocker* or *roller joints*

precision drives

of sprocket, pitch of chain, speed of operation in fpm.

ASA Standard lists two guide link types to keep chain aligned with sprockets. *Center guide chain* has guide links engaging a groove or grooves in sprocket teeth. *Side guide chain* has guides engaging sprocket sides, photos, p 90.

Double flexure chain boasts driving teeth on both sides. It is well-suited where several shafts must turn in different directions, or where a chain take-up device is needed on the backside of the running chain.

Sprockets are available without hubs, with hubs on one or both sides, in split or shear pin type. Some sizes have detachable bushings. For most satisfactory service, use sprockets with at least 21 teeth; 25 for quiet operation. Smaller sprockets with 17 teeth are used.

Silent chain sprockets have cut teeth, are machined from iron or steel. Small sizes are hardened, larger ones either hardened or unhardened. Except for the tooth forms, they are similar to roller chain sprockets, p 89.

Other transmission chains

A wide variety of drive chains of different constructions are available. They are finished to various degrees of precision, ranging from unfinished castings or forgings to chains with some machined parts. Many of them can be fitted with attachments for conveyor use. Here are brief descriptions of the three common types pictured in top panel, page 89.

Detachable chain

Links of this chain are identical, easy to detach. Hook or open end of each link couples with bar end of link next to it.

Available in standard or high-test malleable iron or pressed steel. Chief advantage: They are easy to shorten or lengthen. They are generally recommended for speeds to about 350 fpm; can handle loads to approximately 25 hp.

Malleable detachable chain is cast; steel detachable chain is made from medium carbon nonalloy steel strip, hardened to provide wear and strength to chain joint. This chain is made to ASA Standards.

Pintle chain

Pintle chain links are made of hollow-cored cylinders, cast or forged integrally with two offset side bars. Each link is identical. They are connected by steel pins or rivets.

These chains have greater strength, better protected joints and are of more sturdy construction than detachable link chains, for given outside dimensions and weight. Pintle chain can be used for speeds to about 450 fpm, for somewhat heavier loads than detachable chain. It can be lubricated more readily and if given proper care should have greater life under equal conditions.

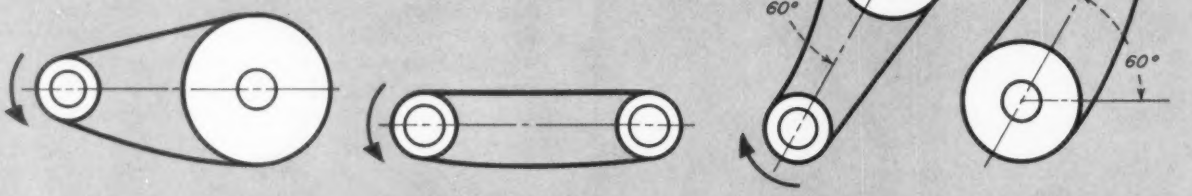
It costs more and is not as readily opened at the link joints for adjusting its length. Many pintle chains are designed to operate over detachable chain sprockets. This cuts plant inventory needs.

Fabricated chain

The steel side-bar transmission chain is extensively used on construction and oil-field machinery. It can be used at speeds to 1000 fpm and over, and loads to about 250 hp. Each link consists of two side bars (either offset or straight), one bushing, one roller, one pin, and sometimes a cotter. Some chains of this general type have been manufactured without rollers.

Certain highly finished steel side-bar chains can be used advantageously with accurately machined cut-tooth sprockets. Others, like detachable and pintle chains, run on cast tooth sprockets. The accurately finished chains require careful lubrication for best service. Check manufacturers' catalogs for details on best applications for this chain.

These recommended drive arrangements will deliver top performance



Speed reducing | **Same speed** | **Driver on bottom** | **Driver on top**

Horizontal drives are good practice. Use adjustable centers if there are load reversals, shock or impulse load conditions

Inclined drives are used where shaft center line is less than 60 degrees from horizontal, but often need center adjustment

SELECTING the right drive: Speed, cost,

More than one type drive can usually be selected for any given job with a good measure of success. Yet, when cost, life expectancy, speed, space and quietness are considered, one chain may stand out as being best for your need. Chart, below, left, gives some selection criteria. But before settling on a chain consider the following as general guides.

Drive arrangements, above, are most often recommended. Plan for adjustable shaft centers to hold the right chain tension and provide take-up for chain wear. Take-up range should be at least 1½ times chain pitch. Use an adjustable idler with fixed shaft centers.

Sprocket teeth play an important role too. As number of sprocket teeth increase for a given rpm, chain speed becomes more uniform and shock loading lessens between chain and sprocket. Do not drop below the maker's recommended minimum number of teeth on a sprocket. Also be sure that sprocket selected will actually fit the shaft, so check diameters.

Remember, with high-speed ratios, size of small sprocket is limited by maximum desirable size of large sprocket. This maximum for roller chains is about 120 teeth. Available space may further limit size of large sprocket. Use stock sprockets where possible. Insisting on an exact speed may mean an expensive, unwieldy installation.

In general, for quietest operation and high speed, use smallest pitch chain that will accommodate hp and other load needs. Trial pitches are charted below and on p 93. For single drives, limit the speed ratios to 10:1. Use two drives in series for greater ratios. Some manufacturers recommend this latter arrangement when speed ratios exceed 5 or 6:1.

Typical characteristics of power-transmission drives

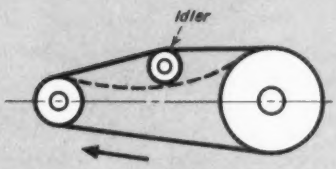
Characteristics	Applicable types of chain			
	Silent	Roller (ASA)	Fabricated or steel roller	Detachable or pintle
Low speeds, such as elevator and conveyor service, lubrication and cleanliness impractical*		x	x	x
Power-transmission primary drives, light and heavy	x	x		
Power-transmission secondary drives		x	x	x
Light conveyor and elevator service, under clean conditions; not necessarily lubricated*		x	x	x
Heavy conveyor and elevator service			x	x
Speeds up to 450 fpm	x	x	x	x
Speeds up to 1000 fpm	x	x	x	
Speeds over 1000 fpm	x	x		
Ratios up to 5 to 1	x	x	x	x
Ratios up to 10 to 1	x	x		
Ranking as to operation smoothness, at equal speeds	1	2	3	4

* Malleable and rough finished chain preferred, because of larger joint bearing area.

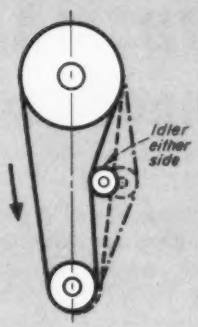
Trial pitch sizes for silent chain

Rpm of small sprocket	Trial pitch, in.
3000–5000	⅜
1800–3000	½
1500–2500	⅝
1200–2000	¾
900–1500	1
700–1200	1¼
600– 900	1½
400– 700	2

Use adjustable idlers if you adopt these layouts

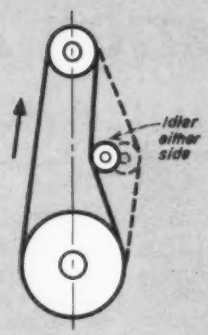


Slack side on top

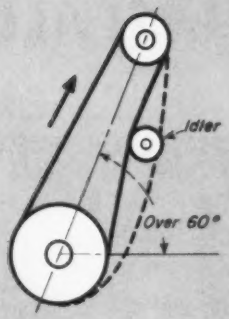


Driver on bottom

With slack side on top, idler prevents chain from backbending, slack strand from hitting tight strand as chain wears



Driver on top



Steep incline

Vertical and steeply inclined drives require some means to adjust slack-side tension. Note direction of chain travel

operating noise are key factors

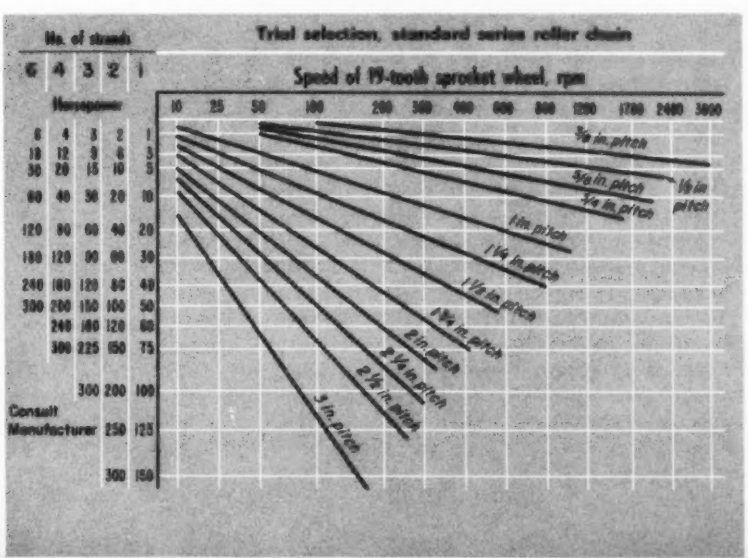
Shaft center distance should get some heavy thought too. *Example:* Best practice dictates shaft center distances equal to 30 or 50 pitches. Shoot for an arc-of-chain-engagement of about 135 deg, with 120 deg as minimum. Maximum center distance should be within 80 pitches.

Chain length is a function of center distance and number of teeth in each sprocket. To avoid use of offset links, hold length to an even number of pitches.

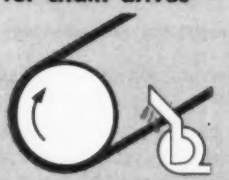
Selecting a specific chain drive, sizewise, boils down to thumbing through manufacturers' catalog rating tables, after gathering preliminary info. What's needed? (1) Hp to be transmitted (2) full load speed of driving and driven shafts (3) shaft diameters (4) shaft center-to-center distance (5) drive position, space limitations (7) service conditions, operating hours, type loading, available lubrication.

Hp rating tables for ASA standard roller chain are based on a life expectancy of 15,000 hr, with optimum conditions and service factor of one. ASA silent-chain ratings are based on a 20,000-hr life. Note: To figure chain capacity, power to be transmitted must be multiplied by service factor, see catalogs.

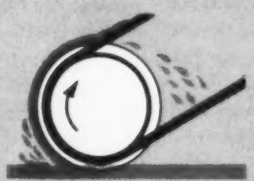
Lubrication is one important key to trouble-free chain life. Proper lubrication insures minimum wear, plus keeping joints free of dirt. Typical lube application methods are shown at right. See p 94 for more info.


No. of strands
6 4 3 2 1
Horsepower
Trial selection, standard series roller chain
Speed of 19-tooth sprocket wheel, rpm
10 25 50 100 200 300 400 600 800 1200 1700 2400 3600
3/8 in. pitch
5/8 in. pitch
1/2 in. pitch
3/4 in. pitch
1 in. pitch
1 1/4 in. pitch
1 1/2 in. pitch
1 3/4 in. pitch
2 in. pitch
2 1/4 in. pitch
2 1/2 in. pitch
3 in. pitch
Consult Manufacturer

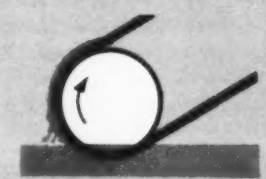
Lubrication systems for chain drives



Forced feed is used for large horsepower, high-speed drives



Disk lubricator carries oil to chain with lifting motion

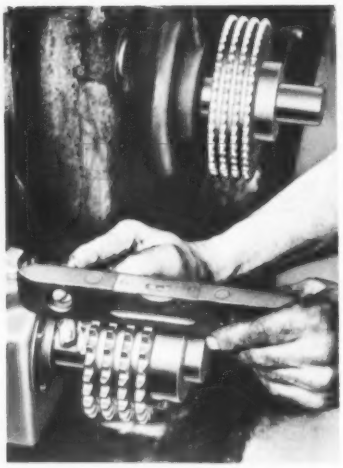


Splash system. Lower arc of chain runs through oil bath

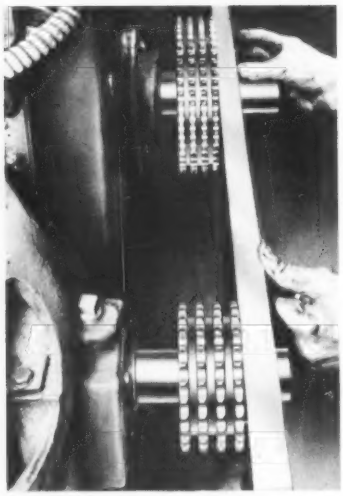
Drip feed. Wick-filled pipe is fed from a sight-feed cup

Manual method. Oil is applied by brush at periodic intervals

INSTALLATION AND MAINTENANCE— where good practice pays off



Start by aligning shafts . . .



then align the sprockets . . .

finally, install the chain

Select the right chain, install it with care, lubricate when necessary, inspect periodically and you have the main ingredients for a long healthy chain life.

Installation starts with shaft alignment. Check this by using a machinists' spirit level, photos, left. Measure distances between several corresponding points on shafts to insure they're parallel. Sprockets' axial alignment can be checked with a straightedge or taut wire on the finished sides. If shaft has axial float, block it in running position before checking alignment. Tighten set screws. Recheck alignment before installing chain.

First step in chain installation: Remove connecting link. Next, wrap middle of chain around one sprocket and engage chain's free ends with teeth on far sprocket. Then reinsert connecting link.

Chain tension is right if chain can be flexed slightly with one hand. Another check: Turn one sprocket, tightening lower strand. Then place straightedge over upper span and pull chain down at center. Sag should measure about 2% of center distance. Vertical or inclined drive should have less slack than horizontal one to insure proper mesh with lower sprocket. Make your final adjustment check with chain running under load. If it whips there is too much slack.

Lubricating oil is applied to chain edges penetrating bushing joint to pin. Use brush, drip or splash systems where chain speed is below 600 fpm. From 600 to about 1600 fpm, utilize fast drip, splash, disk or pumped forced-feed automatic methods. Above 1600 fpm, continuous lubrication using a disk or pump, is often recommended, sketches, p 93.

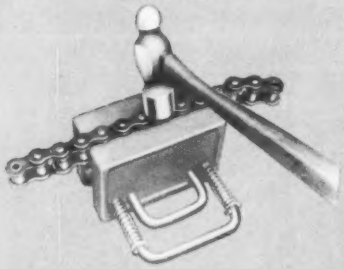
Roller and silent chains are normally lubricated by a medium- or light-viscosity pure mineral oil. Detachable and pintle chains, where lubricated, use a heavy gear lubricant. Figure on dust- and oil-tight casings for high-speed drives.

Periodic inspection. Check for wear on sides of sprocket teeth and link plates. Wear indicates misalignment. Check sprocket and shaft alignment and look for worn sprocket teeth. Turn or replace sprockets that have hook-shaped teeth.

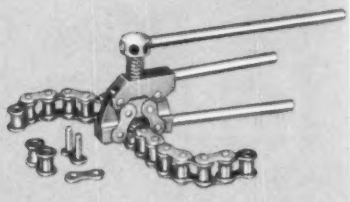
Normal wear causes gradual increase in chain length. A sudden increase may indicate (1) lubrication failure (2) excessive over-loading or shocks (3) displacement of bearing (4) take-up failure or displacement.

Check for cleanliness and inspect lubricant system. When necessary, remove chain and clean in kerosene. Soak chain in oil before replacing. Drain, flush and refill oil reservoirs at least once a year.

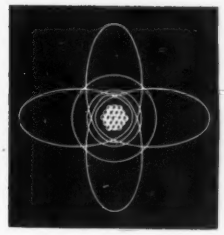
These accessories speed chain maintenance



VISE is useful for altering chain. Hammering shears off rivet head without need for preliminary grinding. Pins can then be punched out to disassemble chain. Device can be used on installed chain with a backup



PIN EXTRACTOR forces pin through link plate to disassemble chain. *Remember:* For any installation you're courting trouble if a new link is inserted in a worn chain . . . or new chain used on badly worn sprockets



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Power Reactor Development Company, builders of 100-mw sodium-cooled fast breeder reactor for Detroit Edison Company, will receive up to $4.5 million assistance from AEC. This will be in form of research and development work, consulting and information service, training of operators and maintenance men. Of $47 million spent by PRDC, $33 million will be for reactor plant. AEC will waive charge for special nuclear materials for 5 years beginning contract date—value about $5 million. PRDC must report technical and economic data to AEC.

AEC enlarges its program to help private scientists and engineers widen their work experience in nuclear areas, giving mutual benefit to AEC and employers. Interested organizations should contact Director, Division of Civilian Application, Atomic Energy Commission, Washington, D. C. Salaries and expenses of men assigned to AEC labs and plants will be paid by the men's employers.

High-temperature reactors of the future will need materials other than those now being developed like titanium and zirconium. To work in the 2000-4000 F range molybdenum and niobium hold best promise, though tungsten will be restudied. Rhenium and other rare earth metals are being eyed critically for this service. High-temperature operation needs metals with high strength-to-weight ratio, good oxidation resistance, good stress resistance and must be stable under radiation.

Britain's nuclear power plant program envisions building 16 plants during next 9 years in England, Scotland and Wales and one in Northern Ireland in addition to 3 now building. Total capacity will be from 5000 to 6000-mw; will replace need for burning 18 million tons of coal annually. These plants will cost from $350 to $415 per kw, excluding fuel. Two plants now building (275 and 300 mw) will cost about $390 per kw, excluding fuel.

Uranium enrichment influences nuclear plant costs: Yankee Atomic Electric Co plant in Rowe, Mass., using pressurized water and steel-clad uranium-oxide fuel elements with 2.7% enrichment will cost about $260 per kw and have 134-mw capacity. Reactor uses 25 tons of uranium. Dresden boiling-water reactor plant in Illinois uses 60 tons of 1.5%-enriched uranium and will cost about $250 per kw. An improved 150-kw Calder Hall gas-cooled reactor (British) needs 250 tons of natural uranium and costs about $390 per kw, excluding fuel.

EURATOM, joint atomic organization of France, West Germany, Italy, Belgium, Luxembourg and the Netherlands, plans to install 15,000 mw of nuclear plants by end of 1967. Pressure for large-scale nuclear power plants in England and western Europe stems from their lack of fossil fuels. Power demands are outstripping their natural resources. At this time, cost of nuclear-generated power will be competitive with imported coal and oil which cost about double their domestic fuels.

Current reserves of uranium ore in the U.S.A. are estimated at about 60 million tons. If we assume a concentration of ¼% this equals 150,000 tons of natural uranium. At 100% burnup this would yield 11.6 quintillion Btu (10^{18} Btu). U.S.A. energy consumption for all purposes during 1956 equalled about 42 quadrillion Btu (10^{15} Btu). So at the 1956 rate of energy consumption we have about a 275-year supply of energy in sight. Our fossil fuels at the same rate will last about 165 years—so total energy in reserve is about 440 years.

NO. 9: MOTOR CONTROL

Planning a major change in motor control gear requires know-how on available types of equipment, plus practical techniques for scheduling the installation with little downtime. Case-in-point is Detroit plant of U.S. Rubber where their electrical engineer Kurt John played a key role in developing a . . .

PTG approach to motor-starter replacement

► FOR SOME YEARS a long range electrical modernization program has been underway at the Detroit plant of U.S. Rubber Co. There are several stages of the program, varying in complexity from changing the power plant bus arrangement to replacing old motor starters.

Early stages of the program saw cell-mounted obsolete circuit breakers bow out to modern metalclad switchgear, arranged in a synchronizing bus scheme. The four main load buses, bus tie reactors and outgoing feeder reactors were arranged to cut available short circuit kva to acceptable values. But the distribution voltage remained at 2.4 kv. About 15 years ago, a fifth main bus was added and the plant electrical system synchronized with the utility's. This setup had two main buses fed by the utility while the three remaining were handled through the U.S. Rubber Co generators.

During 1950 the 480-v power and lighting distribution system in the main manufacturing buildings was modernized. Oil-filled transformers and open switchboards were replaced with modern unit substations for 480-v power distribution. Four 2.4-kv lighting risers, feeding 225- and 112½-kva lighting transformers at load areas, were installed. Lighting voltage was switched from 120 v, 3 phase, 3 wire, to 120/208 v, 3 phase, 4 wire.

The PTG angle, *at least in part, comes in since all modernized and new equipment can be reconnected from 2.4 to 4.16 kv if need be.*

After more preliminary work, the planned replacement of obsolete mill motor starters began in earnest. This part of the job proved the toughest because of the plant's heavy production schedules.

Original plan called for replacing these starters in several steps. The stages were to involve (1) buying a new mill motor (2) modernizing the particular mill drive (3) installing a new motor starter. But further probing showed the existing mill motors were rated either 300 or 600 hp at 1200 rpm synchronous. Their low starting torque made it necessary to use large electric clutches between motor and mill shaft. These motors were designed for reduced voltage starting only. New motors would, naturally, be selected for across-the-line starting, with sufficient starting torque to eliminate the electric clutches, yet supplied with dynamic braking. They would be reconnectable from 2.3 to 4.16 kv.

But practical considerations made a change in plans imperative. First off, to follow the piecemeal replacement schedule would require excessive downtime. Also, since there was some necessary shifting and regrouping of electrical equipment, the installation job on a planned piecemeal basis began to appear unattractive. Finally, the old starters were showing signs of gasping for their last breath at any moment.

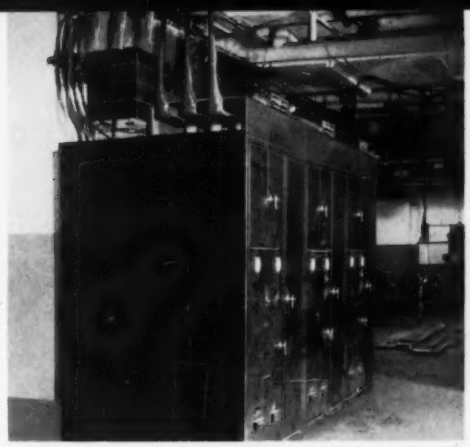
Revamped plan centered around dismantling entire old-starter cell wall in one operation, installing new starters, deferring motor replacement unitl later. This meant using the old motors on new starters. Keeping power to grow in mind, it appeared extremely impractical to buy reduced-voltage starters for all present motors then, in a short period, wind up with new across-the-line start motors.

So next step was to see what could be done with existing motor windings to make them suitable for across-the-line starting. Motor windings were braced by inserting insulating spacers between coils. These spacers were tied in place, then varnished. The old motors have been on across-the-line starting for over a year now without a significant rise in the rate of motor failures. Actual changeover was handled in four steps, facing page.

Starters and controllers for high-voltage ac motors—601 to 5000 v—are generally considered as control rather than switchgear (POWER, Oct 1955, p 98). To appreciate the current picture let's review some of the fundamentals of high-voltage ac motor control with the PTG angle well in mind.

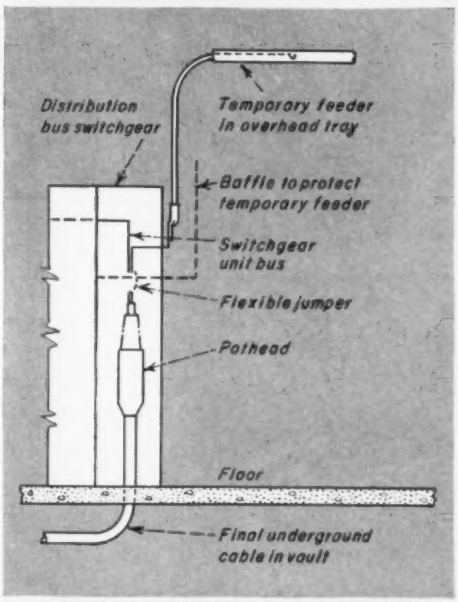
NEMA *Standards for Industrial Control* govern their design. High-voltage-motor branch circuits between controller and motor represents an extension of the power-distribution system. Faults on a motor's branch circuits are hazards to this (*Continued on page* 98)

1 STARTERS IN TEMPORARY LOCATION. Eleven motor starters were grouped into three motor buses. Drives were grouped as per the final layout. Motor buses, in their temporary location, were fed by temporary cables originating in a switchgear position intended for future permanent operation of the same motor bus. Open rubber-covered 500-mcm 5-kv single-conductor cables were run overhead and supported within expanded metal trays. To minimize time lost, underground cable was installed from the same distribution bus position to the final location of the motor bus.



2 TEMPORARY FEEDERS were connected directly to switchgear buses with baffle, permitting later installation of final underground cable. Pothead could be completed while switchgear remained in service.

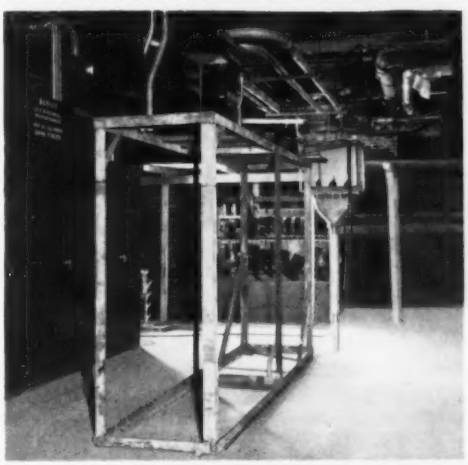
Field circuits, supplying 250-v dc to synchronous motors, were laid in as temporary wiring in overhead open trays. Temporary ground connections tied into motor bases and overhead trays. Lead wiring, suitable for future larger motors, were installed for each existing motor. This wiring went into permanent conduit running from motor terminals to main substation where they terminated in pull boxes. All wiring was brought out through cover openings in pull boxes, permitting conduit to be extended to final location.



3 STARTER TEMPLATE was made up matching the mounting dimensions of a motor bus with three starters. Incoming cable pothead, all outgoing conduits and stress cone boxes for high-voltage motor leads were located precisely on the structural steel rig. The rig was then anchored in final position of the motor bus. All final conduits and most wiring were installed beforehand.

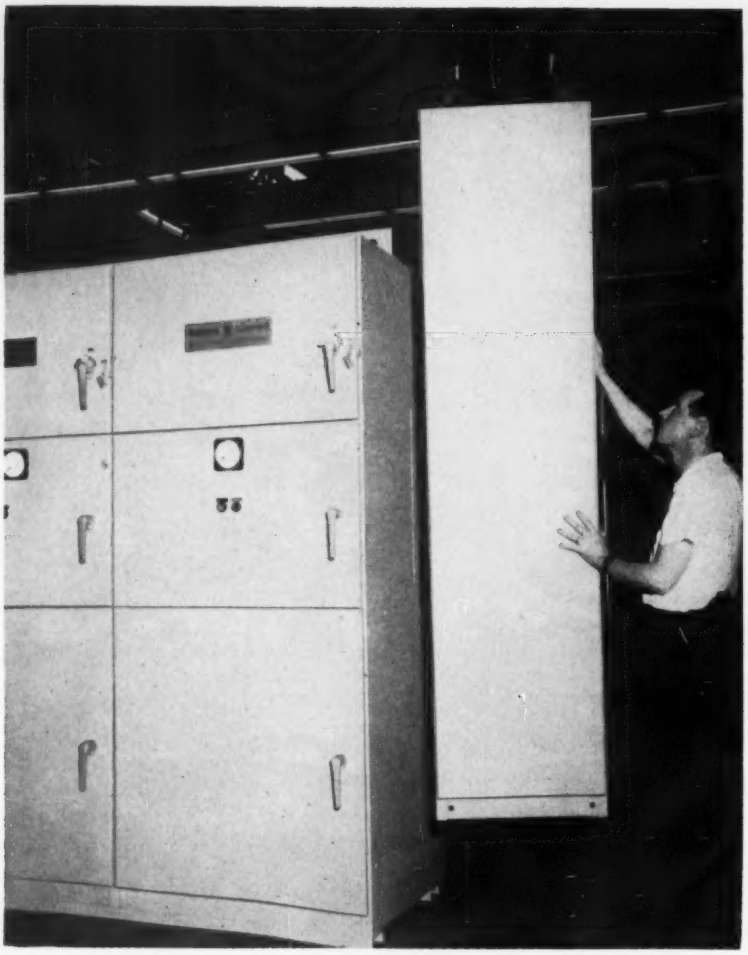
During shutdown, starters were cut loose, temporary wiring removed, starters moved and connected to permanent wiring. This temporary rig saved its cost many times.

At the distribution bus switchgear unit, temporary feeder cables to motor bus were removed and jumpers reinstalled to connect switchgear bus to pothead of final motor bus.



4 FINAL LOCATION for motor starters became a reality after about 12 months; time to handle all the phases of installation. Individual starters were transferred to final location, one at a time. Typical motor transfer could be completed during a weekend by disconnecting old wiring leading to obsolete starters and connecting new wiring to stator, field and control.

On some weekends several motors were handled, permitting all motor transfers to their respective new starters without serious loss of production time. Old motors were rebraced for across-the-line starting.



FACTORY-ASSEMBLED controllers available as high-voltage current-limiting fused starters for coordinated control of squirrel-cage, synchronous, wound-rotor motors

"All new equipment can be reconnected from 2.4 to 4.16 kv—a PTG factor"

system, hence power-service engineers are interested in performance specifications of high-voltage controllers connected to their lines.

NEMA *Standards* for high-voltage controllers are based on the premise that faults on branch circuits cannot be avoided by economical means. Therefore, select high-voltage motor controllers that have adequate interrupting capacity to clear faults on branch circuits without endangering the power system.

***Class E* controllers.** Before industrial power lines were interconnected with large metropolitan utility systems, it was common to use *Class A* controllers, with interrupting ability of ten times rated motor current. These can handle motor overloads up to stalled-rotor currents, but are not adequate for short-circuit currents. Protection against short circuits was left to feeder breakers, which were usually oil type having an interrupting time of about eight cycles.

This controller-breaker combination does not give adequate short-circuit protection for motor branch circuits connected to modern industrial power systems. NEMA has abandoned *Class A* designation for high-voltage controllers, but it still exists for low-voltage designs. This means NEMA no longer recognizes as standard high-voltage controllers having an interrupting ability of ten times rated motor current. NEMA has adopted a *Class E* designation for high-voltage controllers with a stated high interrupting ability, considered standard for use on high-voltage-motor branch circuits.

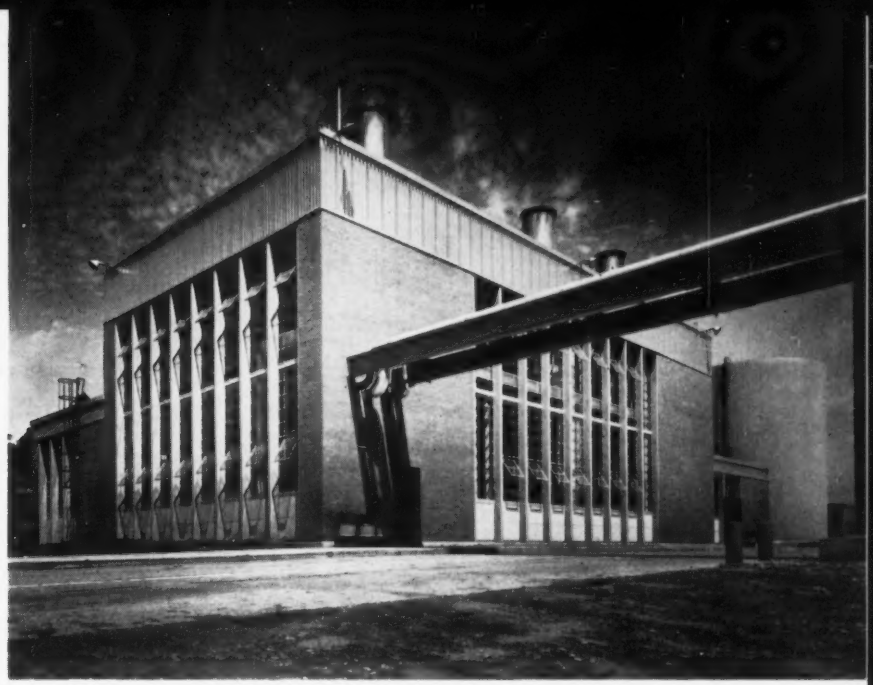
Short-circuit current. Two classes of controllers are in general use, *E1* and *E2*. *Class E1* uses controller main contacts for interrupting motor load, overload and short-circuit current. Components handling the main power circuit may be circuit breakers or contactors, either air break or oil immersed. These breakers or contactors must have an interrupting capacity adequate for the motor branch-circuit short-circuit fault current.

Class E2 controllers use controller main contacts for interrupting load and overload currents, and fuses for short circuits. Power switching components are frequently manually operated switches or contactors. These need have only an interrupting rating of ten times rated motor current. Fuses may be the so-called power type that clear the fault in about one cycle. Also used are current-limiting fuses, which melt before the short-circuit current reaches its crest value within its first half cycle. These fuses must have adequate interrupting capacity, and controller design has to be such that the fault is cleared by the fuses, not by controller contacts.

Controller selection. Short-circuit current that flows into the fault is determined by power-system impedance from the source to the fault, and what other motors connected to the system contribute.

Short circuits on a branch circuit may occur at any point between controller load and motor terminals, or even inside the motor. Impedance between controller and motor has a current-limiting effect. Highest short-circuit current flows when a bolted short exists at the controller's load terminals. While such a fault is not likely to occur during normal operation, it may be closely approached when equipment is started for the first time. Tools may be dropped or left so as to bridge the load terminals. Or phases may be tied together because of a mistake in connections, easily made when reversing or on part-winding controllers. Hence, it is assumed that the controller must be capable of interrupting a bolted fault with zero impedance at its load terminals.

Magnitude of controller impedance varies with geometry of current-carrying parts and is affected by motor rating, size of overload relay coils and heaters, current transformers and other parts.



Sikorsky's power service setup: A top example of...

Today's design practice for medium-sized plants

By R M DOERING

Member, Albert Kahn Associated Architects and Engineers

► DEMAND FOR HELICOPTERS grows by leaps and bounds as this versatile machine continues to prove its value in a hundred and one applications. United Aircraft Corp's new plant—operated by their Sikorsky Division at Stamford, Conn.—is a result of this demand.

Plant's electrical- and mechanical-system design, its boiler house in particular, resulted in its selection by *Factory* magazine as one of the most significant plants erected in the U.S. in 1955.

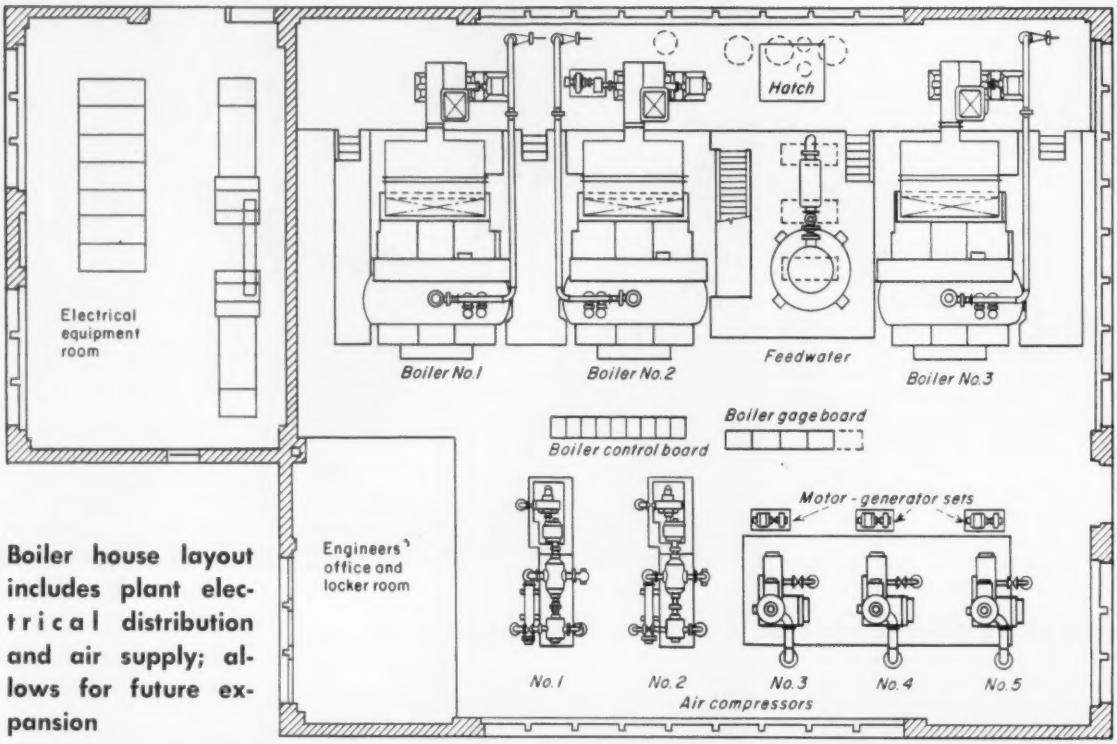
Heating, ventilating and air conditioning of production areas stems from a system of 30-psi unit heaters and ventilators. A 5-psi system furnishes steam for blast coils of air-conditioning and ventilating units serving offices and cafeteria. The 5-psi steam also heats water for a separate forced hot-water wall-convector system for office and cafeteria heating.

Separate air-conditioning units, used in offices and blade room, have zone control. Water supply to the chilled water coils is at 45 F, which lowers moisture content enough to hold the 50% relative humidity required in the blade room.

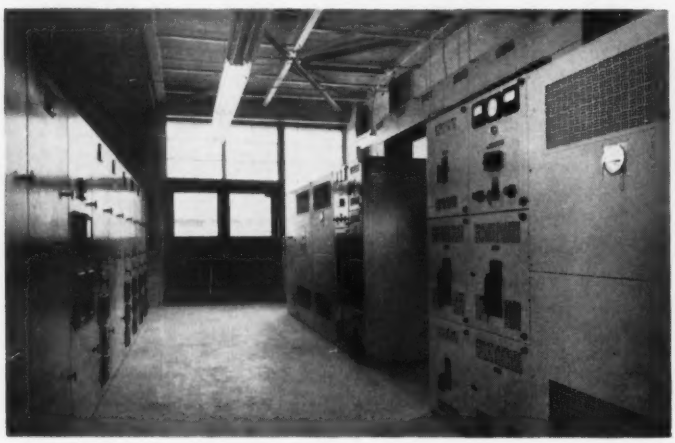
Electrical distribution radiates from the boiler house. Incoming 13.8-kv service terminates in a 15-kv switchgear section, goes to an outdoor voltage regulator, then returns to the "regulated bus section" of the 15-kv switchgear. Feeders spread from here to the 480-v double-ended substations in the boiler-house proper and to substations in the manufacturing areas. A third section of the primary switchgear, the "unregulated bus," feeds remotely located test stands. All services run through underground fiber ducts from a cable vault below the primary switchgear in the boiler house.

The three, 2-drum bent-tube type boilers have waterwalls and air preheaters. Designed to operate continuously at 40,000 lb per hr capacity, 175 psi, each unit can put out 44,000 lb per hr for two-hour periods.

Preheaters raise air temperature to about 314 F at maximum continuous



Boiler house layout includes plant electrical distribution and air supply; allows for future expansion



ELECTRICAL equipment room, center of distribution system, houses transformers, switchgear. The 13.8-kv primary radiates to substations at 480 v

SODIUM-ZEOLITE softener system, boiler drum chemical-feed pump are automatic, easy-to-get-at

load. Duct work brings forced draft through individual preheaters to boiler windboxes. However, during very low load conidtions, forced draft by-passes the preheaters (to avoid dew point conditions in the units), goes directly to windboxes. Two boilers have motor-driven f-d and i-d fans. Third boiler's fans have both motor and turbine drive.

Burners, steam-assisted pressure atomizing, are variable capacity type; have flame-failure scanners. Fuel-supply system includes seven 20,000-gal storage tanks, complete with heaters, pumps and controls. These are tied in with boiler combustion controls to give completely automatic firing over entire load range. Piping from tank farm to boiler house is encased in presealed underground conduit.

Automatic combustion control is metering type. Following manual startup, system takes over, operates one or all boilers to maintain constant steam pressure regardless of demand. Air for operation of controls normally comes from the plant-air system, but a stand-by motor-driven compressor can kick in if needed.

Steam flowmeter (recording, indicating and integrating type), gages and other temperature and pressure indicating and recording instruments make up the central control panel located on the operating floor. Individual boiler subpanel sections and master panel

PRINCIPAL BOILER HOUSE EQUIPMENT

Steam generating equipment

Boilers, 3 — Wickes Boiler Co
Two drum, bent tube, 40,000 lb per hr continuous, 175 psig, 1580-cu-ft furnace, 5562-sq-ft heating surface

Oil burners, 6 — Todd Shipyards Corp
Model D-16, variable capacity steam-assisted atomizing burners

Oil heaters, 3 — Griscom-Russell Co
Discharge heaters, 1200 gal oil per hr, 90 to 225 F

Forced-draft fans, 3 — Buffalo Forge Co
53,500 lb air per hr, 6.05-in. wg, 100 F, 12,600 cfm, single inlet, variable inlet vanes, class II, two motor-driven; one motor- or turbine driven

Induced-draft fans, 3 — Buffalo Forge Co
60,300 lb gas per hr, 4.6-in. wg, 405 F, 21,100 cfm, single width, single inlet, one unit set up for dual drive, two motor-driven; one, motor- or turbine-driven

Soot blowers, 3 — Copes-Vulcan Div, Blaw-Knox Co
Model P-3, steam operated, mechanically valved, manually operated rotary-type head

Feedwater equipment

Feedwater heater, 1 — Permutit Co
Deaerating spray type, 140,000 lb per hr outlet capacity, direct contact, vent condenser, 2500-gal storage

Feedwater regulators, 3 — Copes-Vulcan Div, Blaw-Knox Co
Direct-operated two-element type, 45,000 lb per hr, 25-psi minimum excess pressure

Feedwater pumps, 3 — Ingersoll-Rand Co
Horizontally split, two stages, single suction, volute type; two 165 gpm, 645-ft head, 3450 rpm; one, motor-driven, one turbine-driven; one, 60 gpm, 645-ft head, 3450 rpm, motor-driven

Miscellaneous equipment

Air compressors, 3 — Ingersoll-Rand Co / The Fuller Co
Two, Ingersoll-Rand XLE-2, two stages, 110 psig, 1133 cfm actual free air, synchronous-motor-driven; one, Fuller rotary, 600 rpm, 1025 cfm actual free air, steam turbine driven

Air-intake filters — Dollinger Corporation

Water-treating equipment — Permutit Co
Two, sodium zeolite softeners

Chemical treatment — Hall Laboratories, Div Hagan Chemicals & Controls, Inc

Chemical pumps — Milton Roy Co

Flame-failure equipment — Wheelco Instrument Div, Barber Colman Co

Combustion control-metering equipment — Republic Flow Meters Co

Continuous-blowdown equipment — Madden Corp

Cooling towers, 2 — Marley Co
Model 503, packaged-type tower, 250 gpm each, 86 to 106 F, each unit equipped with 2-hp fan

Electrical equipment

Switchgear — Westinghouse Electric Corp

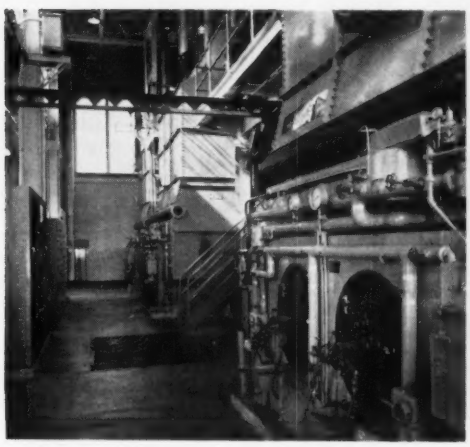
Transformers — Westinghouse Electric Corp

Control and relay boards — Westinghouse Electric Corp

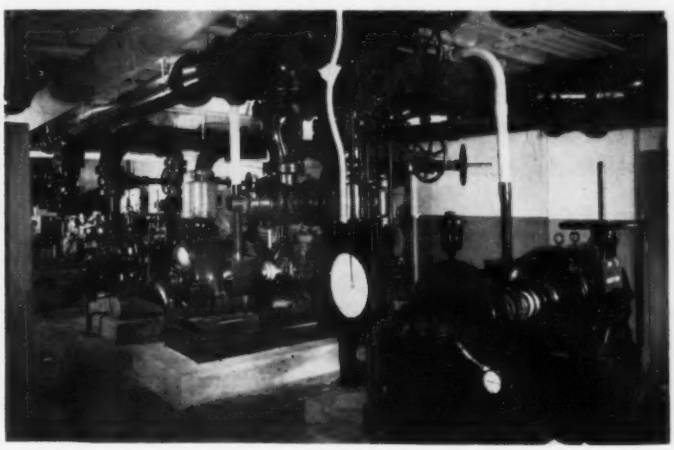
Miscellaneous pumps

Oil pump, 1 — De Laval Steam Turbine Co
Type IMO, electric-driven, 10 gpm

Oil pump, 2 — Dean Bros Pumps, Inc
7x3½x10 in., horizontal, duplex, 20 gpm



BOILER fuel handling, burner and combustion controls give fast automatic response to load swings



FEEDWATER PUMPS, 1 turbine-, 2 motor-driven, run at 645 ft max discharge head. Fire pumps, 2000 gpm, provide water for plant protection

form the complete operating board.

Feedwater treatment employs a fully automatic sodium-zeolite softening system plus automatically regulated feed of chemicals direct to boiler drums.

Condensate from plant buildings returns uncontrolled to a receiver in the boiler-house basement. This float-controlled tank also takes treated makeup. Feedwater goes to a deaerating heater where flow is controlled by a float-operated valve. Exhaust steam to the heater comes through a pressure reducing station which holds pressure at 5 psi.

Boiler-feed pumps, two motor-, one turbine-driven, are multistage centrifugal type, operate at a maximum discharge head of 645 ft. All have pressure-regulating control equipment designed to supply feedwater at constant pressure over entire load range.

Compressed-air system. Three compressors, two synchronous-motor-driven reciprocating and one turbine-driven rotary, each supply 1000 cfm free air at 100 psi. Turbine unit exhausts at 35 psig for heating and process steam needs. (This 35-psig system includes an automatic regulator that maintains the system's pressure from the 175-psig supply.)

Entire plant, including flight and testing facilities covers some 250 acres. Of a total of more than 800,000 sq ft of floor space, about 630,000 sq ft are devoted to helicopter production.

SILICA DEPOSITS on turbine blades reduce turbine efficiency, cause forced turbine outage for cleaning ——►

By **PAUL BRINDISI**
Chemical Engineer, Celco Laboratories

Keep boiler feedwater silica under control

High boiler pressures focus today's water-treatment spotlight on silica. It deposits a glassy coating on turbine blades and helps form tough boiler scale. Here's basic data about these troubles and proven methods of control

► SILICA IN FEEDWATER is a serious detriment to any boiler system. It is a major contributor to scale formation and solids carryover with the steam. Higher boiler pressures have made silica even more troublesome. What causes these harmful effects and how can they be prevented?

Source. Silica is the main part of most minerals composing our earth's crust. It is chemically identified as silicon dioxide (SiO_2) and, in its pure state, is better known as quartz or white sand. Silt, clay, sandstone and ordinary rock formations also contain silica in combination with other ores. The earth is literally full of silica compounds.

Pure water can dissolve minute amounts of silica. So all natural waters contain some silica. Well waters generally contain considerably more dissolved silica than surface waters. Wells receive their water from rain or streams that first seep through alkaline strata. And alkaline waters have a greater capacity for dissolving silica.

Soluble silica in water ranges from a mere trace to over 80 ppm. It may constitute as much as 35% of the total-dissolved solids content of natural supplies. Surface waters also carry considerable silica in suspension. These particles are often so fine that they are carried in a highly colloidal state. This considerably magnifies the overall silica problem because colloidal silica is not easily removed by the usual coagulation and filtration treatment.

Scale formation. Principal salts dissolved in water are normally those of calcium and magnesium. Together they comprise total hardness. Under evaporation these salts concentrate in the boiler water. When boiler-water concentration exceeds solubility limits, they precipitate out. As these deposits cover the metal heating surfaces, they are cemented and baked into scale.

Calcium carbonate and calcium sulfate are both consistent scale producers. Magnesium sulfate usually assumes a minor role. Silica may be present in the scale as silicon dioxide. But more often it is present as calcium and magnesium silicate, equation 1, facing page.

When feedwater silica is fairly low and boiler pressure moderate, silicates falling out of the boiler water will not cause much trouble. Boiler scale will be of the carbonate-sulfate variety. Such deposits give plenty of trouble. But, as the feedwater silica and boiler operating pressure increase, silicates take a more prominent part in scale development. The greater their inclusion, the tougher is the deposit.

Calcium and magnesium silicate are glassy in nature. Because of this, silicate incrustation may escape early detection. Combination of silicates and other scale-formers produce a denser

and more adherent scale mass. Silicates are excellent insulators and severely curtail heat transfer. *Result:* Heat loss and greater fuel consumption, particularly in smaller boilers without multipasses or economizer section.

Insulating effect of the silicates also accelerates tube failure. Tubes blister and rupture with far less silicate scale than is the case with a carbonate-sulfate scale alone. At relatively high boiler pressures, even the thinnest deposit is dangerous. So silica as well as hardness cannot be permitted to accumulate in the boiler water.

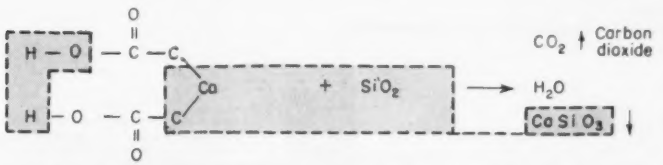
Scale removal. Carbonate - sulfate scale yields to either mechanical or acid cleaning. It becomes more difficult to remove as the proportion of sulfate increases. This component is denser and far tougher than carbonate. Inclusion of silicates makes scale extremely resistant to both mechanical and chemical removal. Where silicates dominate scale composition, usual acid cleaning is virtually useless. Only hydrofluoric acid will attack silicates and its use is certainly not practical for boiler cleaning. Repeated chipping or turbining is the only recourse.

Water treatment can dissolve scale during actual boiler operation. Phosphates, under favorable alkaline conditions, are used to do the job. Carbonate and sulfate constituents are gradually returned to solution. Calcium and magnesium are converted to nonscaling phosphates and hydroxides. Silicates remain as a lacy mat. With the help of an effective organic this is loosened from the boiler metal.

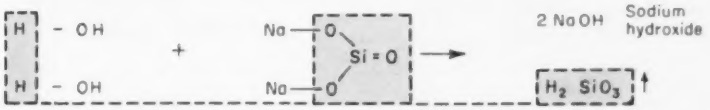
Chemical descaling must be carefully controlled and done slowly. Otherwise, carryover or foaming of boiler water will result. Good removal is possible when the incrustation is not too heavy and silicates are in a definite minority. Higher than normal rate of blowdown is needed and periodic mechanical cleaning may be required.

Carryover. Unlike calcium and magnesium silicate, sodium is quite soluble. High boiler-water alkalinity favors retention of silica in the soluble sodium form. But, if pressure and temperature is high enough, some of this sodium silicate will hydrolyze. See equation 2 on chart at right. It reacts with the boiler water to form silicic acid, which volatilizes and leaves boiler with the steam.

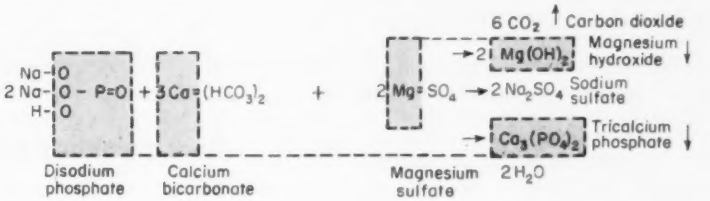
Silicic acid is a harmless vapor until it condenses. This vapor and the steam enter the turbine and expand through the turbine stages. Resulting decrease in temperature and pressure condenses silicic acid on the blades of the turbine. In so doing it dehydrates, depositing silica. A water repellent, glassy



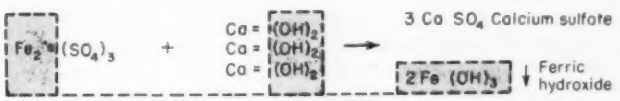
1- Calcium bicarbonate combines with silica to deposit calcium silicate from boiler water



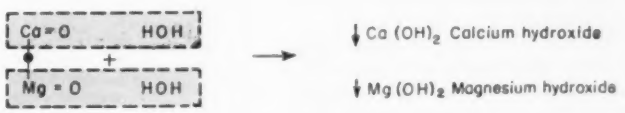
2- Boiler water hydrolizes soluble sodium silicate to form volatile silicic acid



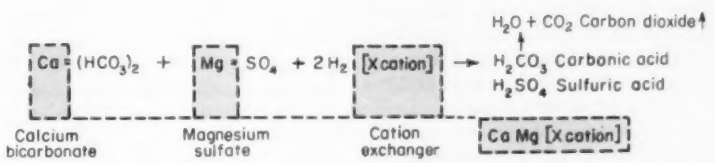
3- Alkaline phosphate precipitates calcium and magnesium hardness from boiler water



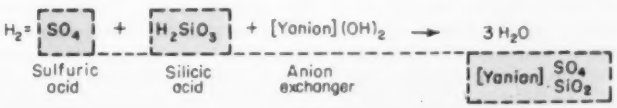
4- Ferric sulfate treated with lime produces silica absorbent floc of ferric hydroxide



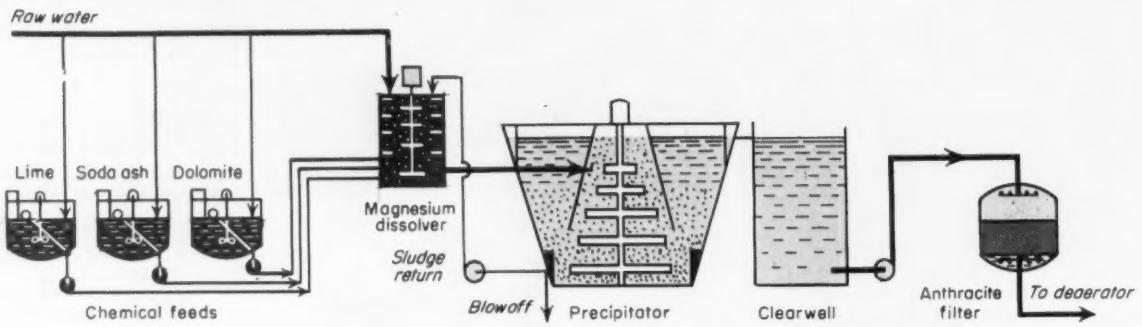
5- Dolomite lime in water also precipitates silica absorbent floc of magnesium hydroxide



6- Demineralization first exchanges hydroxide ions for metallic cations



7- Resulting acid anions are exchanged for hydroxide ions forming water Silica is absorbed. Regeneration uses acid to restore hydrogen ions to cation bed and caustic to return hydroxide ions to the anion exchanger



Cold lime-soda method is one way to reduce feedwater silica to 3 ppm range

and extremely adherent coating slowly builds upon the blades. Turbine efficiency shows a steady drop.

It is very difficult to remove this coating. Sandblasting is one way, but the preferred method is to use a caustic soda bath to redissolve the silica.

Look for this kind of silica carryover at boiler pressures above 600 psi. It has also occurred at pressures as low as 400 psi.

How do you detect the presence of silicic acid in steam? Since it is insoluble in water it can't be detected by testing the condensate. Silica condition in the boiler doesn't indicate its action steamwise.

Best detection method is to check condensate for salts and keep a close watch on turbine efficiency. Carryover of silicic acid is virtually certain if the condensate is always salt free and turbine efficiency steadily drops.

Internal treatment. A limited quantity of silica can be maintained in solution with proper boiler-water alkalinity. To do this avoid any hardness build-up. Otherwise silica will combine chemically with hardness to precipitate scale-producing calcium and magnesium silicate.

Use an alkaline phosphate-organic type treatment for internal conditioning. Phosphate reacts with calcium in the boiler water to form nonscaling tricalcium phosphate, equation 3. Alkalinity furnished has a dual purpose. First, it causes fall out of magnesium hardness as gelatinous magnesium hydroxide. Second, it provides needed causticity to keep silica in solution. The organic acts as a coagulant to render hardness deposits mobile for easy discharge by blowdown.

With higher boiler-water alkalinity, more silica can be kept soluble. But higher alkalinity promotes foaming and priming as operating pressures increase. Higher pressures also increase tendency to vaporize silicic acid. So as boiler pressure increases, lower alkalinity and silica are called for in the boiler water. Table gives recommended safe limits for boiler water composition at various operating pressures.

Internal treatment can handle the job alone when feedwater silica is low and a good volume of condensate returns are recovered. If excessive blowdown is needed to maintain boiler-water silica at desired level, then feedwater silica should be reduced by using external treatment.

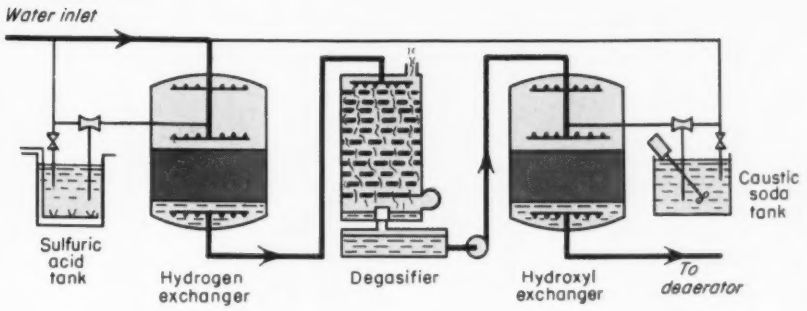
Iron adsorbents. Ferric sulfate reacts with alkali to form a gelatinous

Recommended boiler water limits in ppm

Boiler-water Analysis	Boiler pressure, psi						
	0-300	301-450	451-600	601-750	751-900	901-1000	1001-1500
Hardness	0	0	0	0	0	0	0
P alkalinity	500	420	340	260	180	120	80
M alkalinity	600	500	400	300	220	150	100
Excess phosphate	100	80	60	40	20	10	5
Silica	120	80	50	30	20	10	5
Dissolved solids	2500	2300	2100	1900	1430	1200	980

Operating results from two silica removal methods on the same water

Water analysis	Raw water	Precipitation: Lime-soda dolomite effluent	Demineralization: Hydrogen exchanger effluent	Demineralization: Final feedwater analysis
Total hardness as $CaCO_3$	122.0	51.0	1.0	1.0
Calcium hardness as $CaCO_3$	98.0	43.0	0.8	0.8
Magnesium hardness as $CaCO_3$	24.0	8.0	0.2	0.2
P alkalinity as $CaCO_3$	0	24.0	0	1.0
M alkalinity as $CaCO_3$	104.0	38.0	0	1.0
Sulfate as SO_4	42.0	42.0	42.0	0.4
Chloride as Cl	34.0	34.0	34.0	0.3
Silica as SiO_2	17.0	3.0	17.0	0.2
Carbon dioxide as CO_2	23.0	0	96.0	0
Dissolved solids	299.0	155.0	95.0	2.0
pH	7.1	10.2	3.2	8.3



Demineralization reduces silica to less than 0.1 ppm

floc or ferric hydroxide, refer to equation 4. This voluminous precipitate effectively adsorbs silica from solution. Coloidal silica is also reduced. For best adsorbtive action in the cold, maintain pH in the range of 9.0 to 9.5. Use equipment with at least a half-hour detention in the presence of a fair amount of hardness.

Ferric sulfate usually treats raw water ahead of cold zeolite softeners. Lime is the alkalizer. Moderately high silica can be reduced to 1 ppm. Amount of ferric sulfate required per ppm silica removed varies from 5 to 30 ppm. Actual amount for a given job depends on the initial silica content and amount of reduction needed. Extensive laboratory and field tests are essential to establish specific conditions, control procedure and chemical dosage for best economic results.

Since the ferric treatment increases the sulfate content of the water, its use is limited. Pretreatment of makeup water for high pressures aims to decrease, not increase, the total dissolved solids. So ferric sulfate is limited to operating pressures below 300 psi.

Hydrous ferric hydroxide does not increase the total dissolved solids. Several other iron compounds are also available. But none of these chemicals equal the silica-removing performance of ferric sulfate.

Cold lime-soda. Dolomitic limes contain varying proportions of calcium and magnesium oxides. Lime or calcium constituent is usually better than 60%. When mixed in water, these oxides are converted into hydroxides, equation 5. Resulting flocculent and gelatinous magnesium hydroxide is an excellent silica adsorbent. Both hydroxides are insoluble. Thus, the dolomites have the advantage of not increasing the dissolved solids of the treated water.

Since lime is a principal additive in the lime-soda softening process, the large byproduct of calcium hydroxide is not wasted. High alkalinity and hour detention, employed for good softening, greatly increase effectiveness of the dolomites.

Silica removal increases in proportion to amount of adsorbtive surface exposed. Careful control over density and height of sludge bed is essential for best results. Recirculation of some sludge improves clarification and silica reduction. As much as an additional 50% decrease in silica is obtained with about 10% sludge return. Flow diagram of the cold lime-soda method shows how this can be done.

Cold water requires fairly large doses of dolomite to reduce raw-water silica to a low of about 3 ppm. Anywhere from 30 to 500 ppm is needed depending on the amount of hardness present. Lime in dolomite removes hardness as well as silica. High hardness might consume more dolomite than otherwise needed for silica removal alone. One solution is to use a supplementary lime feed. If a slight rise in solids is not objectionable, use dolomite for partial silica reduction and follow up with ferric sulfate treatment. This method may prove more economical, efficient.

Hot lime-soda. High temperatures increase the silica removal effectiveness of dolomites and magnesium compounds. This is not true of ferric sulfate. Cold magnesium-hydroxide floc acts mainly as a coagulant. Hot magnesium hydroxide does a very efficient job of removing soluble silica. Such is the case with calcined magnesite, magnesium carbonate, magnesium oxide and magnesium sulfate. At boiling temperatures they lower makeup-water silica to 0.5 ppm.

Amount of chemicals needed depends on the raw-water analysis. Often a combination of these silica adsorbents works better than any one used alone.

Filtering medium. Use nonsilicious filtering material. Highly alkaline softener effluent tends to redissolve silica from a sand bed. So graded anthracite coal or iron-oxide ores are used.

Demineralization. High boiler pressures require a makeup water free of dissolved solids. Single or multistage evaporation of raw water was once the only way to produce this kind of water. Now it is common practice to use demineralization. While demineralized water is never absolutely pure, the dissolved solids are reduced to less than 2 ppm with soluble silica often well under 0.1 ppm.

In the demineralization process, two exchange elements convert the natural soluble salts in the makeup into water, equations 6 and 7. Raw water first flows through the hydrogen exchanger where metallic cations of the salts are exchanged for hydrogen. Corresponding acids of the original salts leave with the water. Silica is unaffected.

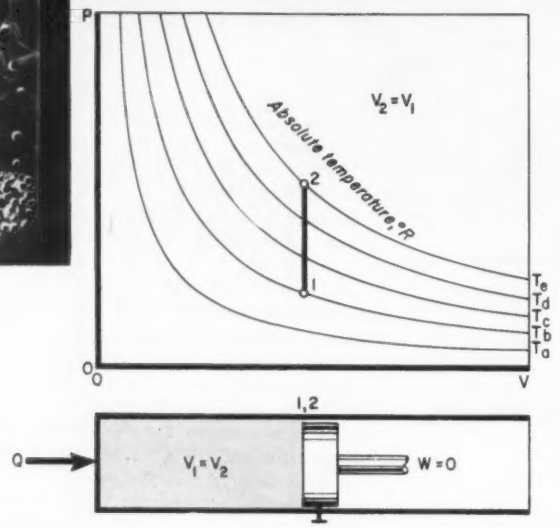
Water then enters the hydroxyl exchanger where hydroxide ions are exchanged for the acid radicals to produce water. Silica is also removed, probably in the form of silicic acid. See flow diagram, above.

When the exchange elements or ion exchangers are exhausted sulfuric acid is used to replace the hydrogen ions and sodium hydroxide to replace the hydroxide ions. This regeneration process discharges the metallic cations and acid radicals to waste as soluble salts. Each ion exchanger is then ready for the next service run.

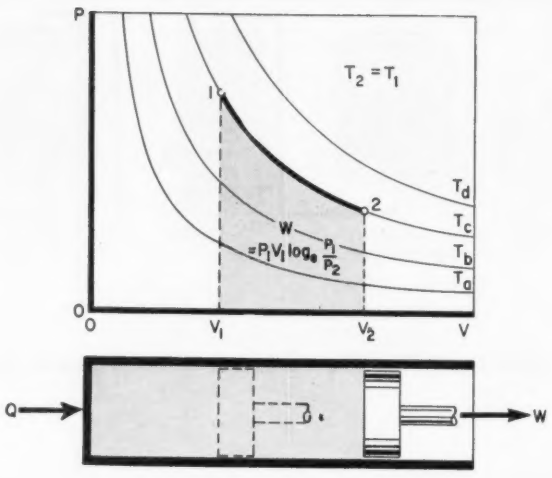
Forced-air degasifier or vacuum deaerator is often inserted between the exchange units to expel the carbon dioxide that is formed in the hydrogen-exchanger effluent.

For operating pressures up to 1000 psi it may be economical to use hot lime-zeolite. Demineralizing is also used in this range. Above 1000 psi, use of demineralized water or its equivalent is mandatory.

Many other demineralizing hookups are in general use today. At today's high boiler pressures, each plant needs its own tailor-made system. Boiler pressure, water analysis, kind of operation, overall cost and possible savings must be considered before selecting the final scheme. Often a pilot plant is useful in establishing the method that will deliver the best results.



1 Constant-volume gas process can only accept or reject energy as heat; it cannot do any form of mechanical work



2 Constant-temperature gas process acts as a transformer of energy; heat transferred exactly equals work done by gas

Gas trapped in a cylinder by a movable piston has the ability to convert heat energy into mechanical work energy. This can be done many ways in . . .

By B G A SKROTZKI
Associate Editor

Gas processes for harnessing energy

► WE BUILT some important tools for ourselves in understanding the conversion of heat to mechanical work in Part 7 (POWER, April 1957, pp 96-98). Make sure you know the meaning of the simple energy equation; $Q = \Delta E + W$, and how each factor can be measured. We also stressed the meaning and importance of the reversible process. We had just finished studying the constant-pressure process with these tools and learned how the general gas equation and simple energy equation were used to analyze it. If you're squared away up to this point, let's look at some more basic processes of gases.

Constant-volume process. In Fig. 1 we take our cylinder full of a perfect gas and lock the piston into place. This holds the gas at constant volume and does not allow energy to enter or leave the gas as mechanical work W, so $W = 0$. On the P-V graph the process line *1-2* appears vertical.

Since a true line has no width, there can be no area under it. This zero area ties in with zero W. In this process, energy can enter or leave the gas only as heat Q. The simple energy equation for $V_1 = V_2$ then boils down to:

$$Q = E_2 - E_1 = c_v(T_2 - T_1)$$

Heating the gas from state *1* to state *2* by the injected Q raises the gas pressure. Cooling the gas from *2* to *1* by extracting heat Q lowers the pressure.

Reviewing our elementary physics of gases, we find this process follows one form of Charles' law (Part 3, Oct 1956, pp 98, 99):

$$\frac{P_1}{P_2} = \frac{T_1}{T_2}$$

In words, the pressure is proportional to the temperature when the volume stays constant. The graph shows this relation directly.

Constant-temperature process. Next let's learn what happens when we control our energy flows in and out of a perfect gas so its temperature stays constant. In Fig. 2 we let our gas expand from volume V_1 to V_2 so its temperature stays constant, $T_2 = T_1$. This means that the internal energy of the gas stays constant, or $E_2 = E_1$, or $E_2 - E_1 = 0$. Then the simple energy equation boils down to:

$$Q = W$$

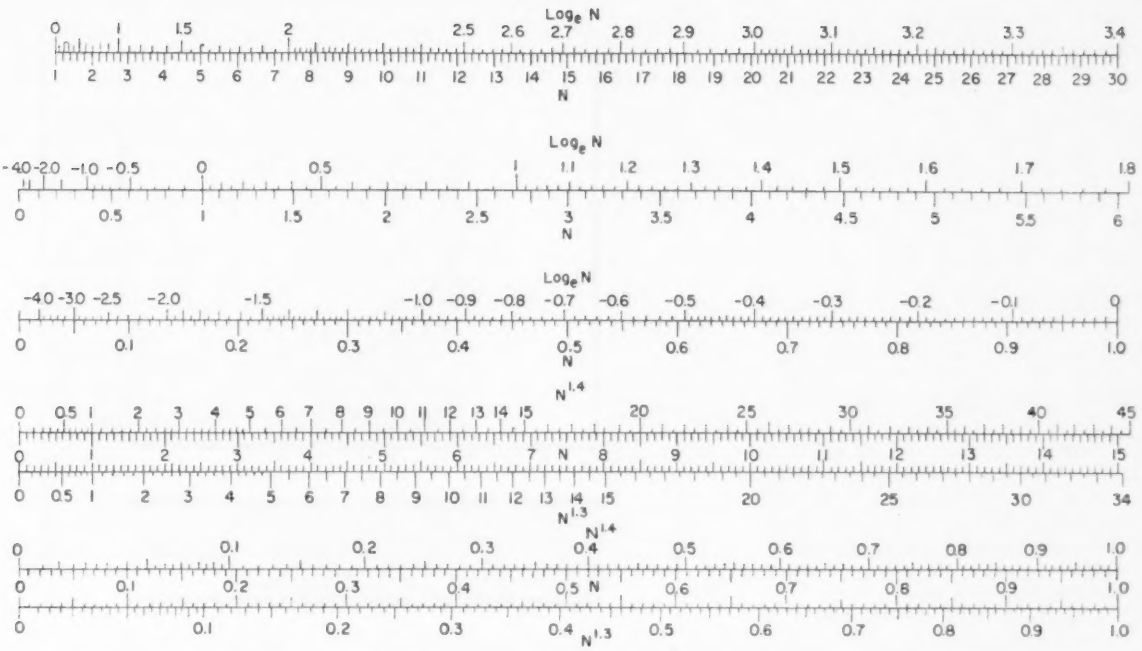
We can become excited about this, because here we can change all of Q into W without affecting the energy content of the gas—a profitable arrangement. Unfortunately, our practical reciprocating engines need more than one kind of process to produce mechanical work—more about this later.

The reverse also holds true for this process; we can change mechanical work into heat without affecting the gas' internal energy, during compression. Pressure keeps changing during the process, rising during compression and falling during expansion. This makes it more difficult to calculate the work W. The area under the constant-T process curve, however, still measures the mechanical work W during compression or expansion.

Since T is constant the gas follows Boyle's law during this process:

$$P_1V_1 = P_2V_2$$

With this relation we can figure a formula for W by using calculus (which



3 Adjacent scales, *upper three*, give natural logarithms for numbers from 0 to 30. Lower two pairs of scales give values of numbers to the 1.3 and 1.4 powers for range from 0 to 15. For greater accuracy use tables of natural logarithms

we won't demonstrate) that takes the form:

$$W = \frac{P_1 V_1}{J} \log_e \frac{P_1}{P_2}$$

Here $\log_e$ means logarithm (to the base number 2.7183) of the pressure ratio P_1/P_2. We can simplify any figuring with this formula by using the adjacent scales in Fig. 3. First reduce the pressure ratio to $P_1/P_2 = N$. Then by spotting N on the scales you can find $\log_e N$ directly above. We'll find out when to use $N^{1.3}$ and $N^{1.4}$ scales later.

How does this process work from the molecular standpoint? During gas expansion, vibrating molecules in the heating surface accelerate the gas molecules toward the piston. At the receding piston face the molecules decelerate as they rebound with lowered speed because they have given up some of their kinetic energy to the piston by doing work on it. The molecules then return more slowly towards the heating surface (head end of cylinder).

These are the underlying motions or transfers superimposed on the chaotic and erratic colliding of the molecules with each other. The higher net speed of molecules from heat-transfer surface to piston counterbalances the lower net speed from piston to heat-transfer surface so that the root-mean-square speed of the molecules, the temperature, stays constant.

During compression processes the molecules are accelerated by the advancing piston toward the heat-transfer surface (now a cooling surface) where they give up part of their kinetic energy to the slower vibrating molecules of the cylinder wall. This makes them rebound with lower speed towards the piston face. The two opposing motions balance out to keep gas temperature constant.

Adiabatic process. So far we have dealt with processes that in turn have kept ΔV, ΔP, ΔE, and W at zero. Now let us see what happens when we keep $Q = 0$. This reduces the simple energy equation to:

$$0 = E_2 - E_1 + W$$

or

$$W = E_1 - E_2$$

This means that we can produce mechanical work, Fig. 4, by letting the gas in a cylinder expand and draw on the internal energy of the gas. In reverse, by doing mechanical work of compression on the gas we can store this energy as a rise in internal energy. These are adiabatic processes, ones with no gain or loss of energy as heat.

We can figure W directly by the simple energy equation since:

$$W = E_1 - E_2 = c_v(T_1 - T_2)$$

Fig. 4 shows that the adiabatic-process curve crosses the constant-temperature curves, as it must with internal energy varying during the process.

Work W also equals the area under the process curve as long as it's reversible. A reversible adiabatic $P-V$ curve for a perfect gas always has the relation:

$$PV^k = C$$

where $k = c_p/c_v$ and C is a constant depending on the gas. For *air* at temperatures near 900 F, $k = 1.4$; for temperatures around 3000 F, $k = 1.3$; see Part 5, Jan 1957, p 98. We can find another formula for figuring W as the area under the curve. Again this must be done by calculus (which we won't show) to get:

$$W = \frac{P_2 V_2 - P_1 V_1}{J\,(1-k)}$$

The general gas equation *always* holds regardless of the process so:

$$P_2 V_2 = RT_2 \text{ and } P_1 V_1 = RT_1$$

substituting these in the work equation we get:

$$W = \frac{RT_2 - RT_1}{J\,(1-k)} = \frac{R}{J} \times \frac{T_2 - T_1}{1-k}$$

For an adiabatic reversible process, since $P_1 V_1^k = P_2 V_2^k$, we can find relations between P and T and between V and T as follows:

$$P_1 V_1^k = P_2 V_2^k \qquad \text{(A)}$$

$$\frac{RT_1}{V_1} V_1^k = \frac{RT_2}{V_2} V_2^k$$

$$T_1 V_1^{k-1} = T_2 V_2^{k-1}$$

$$\frac{T_1}{T_2} = \left(\frac{V_1}{V_2}\right)^{1-k} = \left(\frac{V_2}{V_1}\right)^{k-1}$$

This gives us the relation between T

and V for *reversible adiabatic perfect-gas* processes. Now let's find relation between P and T by substituting in equation (A) from the general gas equation:

$$P_1\left(\frac{RT_1}{P_1}\right)^k = P_2\left(\frac{RT_2}{P_2}\right)^k$$

$$P_1{}^{1-k}T_1{}^k = P_2{}^{1-k}T_2{}^k$$

$$\frac{T_1}{T_2} = \left(\frac{P_1}{P_2}\right)^{\frac{k-1}{k}}$$

These fractional exponents look forbidding, but they quickly disappear when we make numerical substitutions. Fig. 3 will help to find the value of some of the exponential quantities, without using logarithm tables.

Polytropic process. We have looked at specific processes where a state, property or energy transfer has been kept constant or at zero. In the most general case for a process, all factors vary at once in some regular fashion; we call this a polytropic process.

Test of regularity usually consists of examining the process on a $P-V$ graph and finding whether a simple formula will relate all the states. Many practical processes in internal-combustion engines and compressors behave this way, so that the formula $PV^n = C$ describes the process curve.

This equation closely parallels the one for the adiabatic process, the exponent $k = c_p/c_v$ being replaced by n which has no simple relation to the gas specific heats. This being so, we have the interesting situation where all the equations for the adiabatic process also apply to the polytropic by simply substituting n for k and keeping in mind that Q is not zero.

We can figure Q by referring to the simple energy equation:

$$Q = E_2 - E_1 + W$$

substituting the equivalent expressions we get:

$$Q = c_v(T_2-T_1) + \frac{R}{J} \times \frac{T_2-T_1}{1-n}$$

$$= \left[c_v + \frac{R}{J(1-n)}\right](T_2-T_1)$$

$$= \frac{c_v - nc_v + R/J}{1-n}\ (T_2-T_1)$$

Remembering that $c_v + R/J = c_p$ and $k = c_p/c_v$

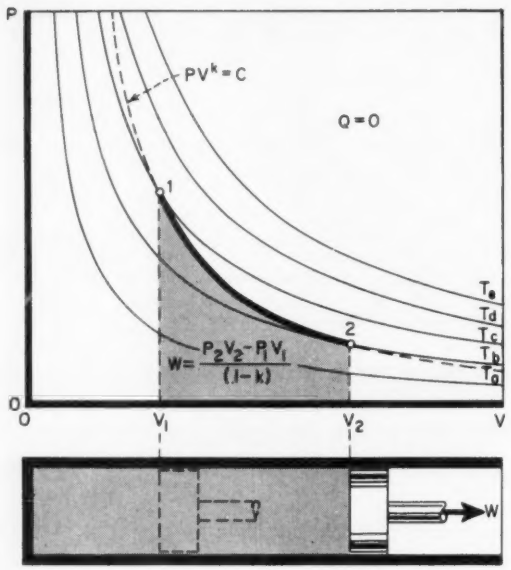
$$Q = \frac{c_p - nc_v}{1-n}(T_2-T_1)$$

$$= c_v\frac{k-n}{1-n}(T_2-T_1)$$

We could replace the quantity $c_v(k-n)/(1-n)$ by c_n and call it the polytropic specific heat, then:

$$Q = c_n(T_2-T_1)$$

Process comparison. The curves for all types of processes have definite relations to each other. Fig. 5*a* shows how the processes are related for expansion or heating or both when the gas is originally in state *1*. Fig. 5*b* gives similar information for a gas when compressed or cooled or both.



4 Adiabatic gas process loses internal energy by doing work or gains it by absorbing work energy, heat energy = zero

Remember the area under these reversible-process curves measure the mechanical work involved, either produced in expansion, or absorbed in compression. The labels on each curve show the value of n when the process is considered as a special case of the general reversible polytropic.

Theoretically a polytropic process can take any direction on the P-V plane, but Fig. 5 shows those of practical importance.

Examples. Let's study a few examples to get the feel of the dimensions involved. Assume we have 0.1 lb of air at 1500 F (1960°R). Then from Fig. 6, Part 5, Jan 1957, p 98, we find c_v = 0.21 Btu per lb and c_p = 0.28 Btu per lb, so $k = c_p/c_v = 0.28/0.21 = 1.33$.

Also from Part 5, p 99, we learned that $R/J = c_p - c_v = 0.28\text{-}0.21 = 0.07$ Btu per lb air and $R = 778 \times 0.07 = 54.5$. This gives us all the constants we need, so let's study each process in turn:

Constant volume: We have the 0.1 lb of 1960-°R air trapped in a cylinder with a fixed volume of 1 cu ft. We heat the air to 2960°R. (1) What is the initial pressure P_1? (2) What is the final pressure P_2? (3) What heat has been transferred into the gas? (4) What mechanical work has been done?

V = 1 cu ft/0.1 lb = 10 cu ft per lb

$PV = RT$

$P_1 = RT_1/V = 54.5 \times 1960/10$
$= 10{,}680$ psfa or

$P_1 = 10{,}680/144 = 74.2$ psia (1)

$P_2 = P_1(T_2/T_1)$
$= 74.2(2960/1960)$

$P_2 = 112$ psia (2)

$Q = c_v(T_2 - T_1)$
$= 0.21(2960-1960)$

$Q = 210$ Btu per lb

$Q = 210 \times 0.1$ lb $= 21$ Btu (3)

$W = 0$ when $V_2 = V_1$ (4)

Constant pressure: We have 0.1 lb of 1960-°R air initially in a volume of 1 cu ft, we expand the volume in a cylinder to 2 cu ft at constant pressure. (1) What is the initial gas pressure P_1? (2) What is the final gas pressure P_2? (3) What is the final gas temperature T_2? (4) What heat Q has been transferred into the gas? (5) What work W has been done by the gas on the piston? (6) What has been the rise in internal energy ΔE of the gas?

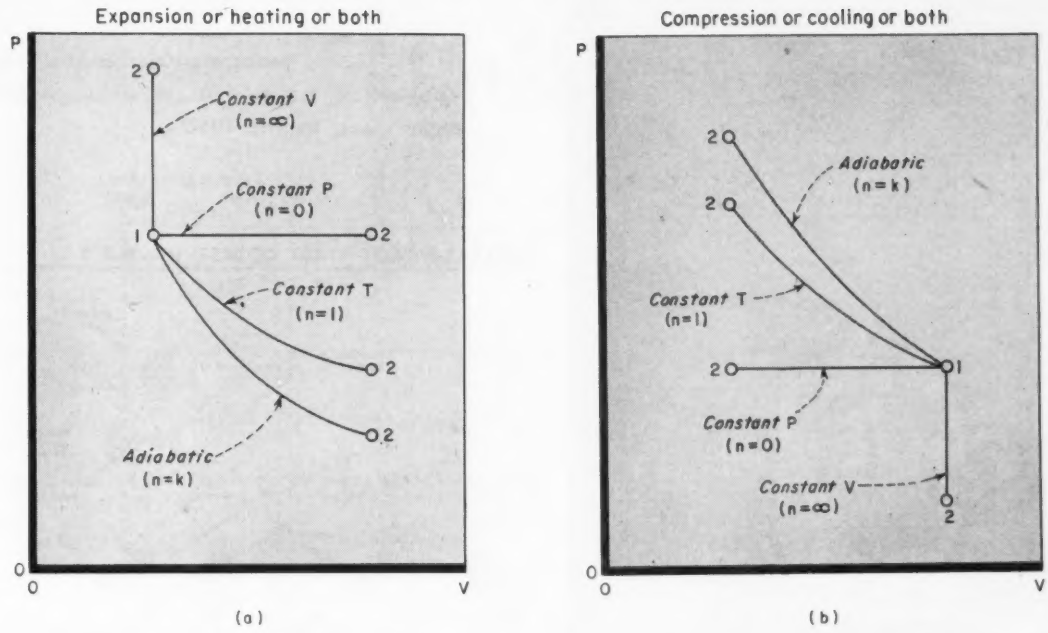
As found for the constant-volume process, P_1 = 74.2 psia (1)

By definition $P_2 = P_1 = 74.2$ psia (2)

V_2 = 2 cu ft/0.1 lb = 20 cu ft per lb

$T_2 = P_2V_2/R$
$= 74.2 \times 144 \times 20/54.5 =$
3920°R (3)

$Q = c_p(T_2 - T_1)$
$= 0.28\ (3920 - 1960) = 549$ Btu per lb



5 (a) Most important gas processes that yield work or absorb heat or both can be considered as special cases of the polytropic process, with n taking special values. (b) The same can be done with processes of compression or cooling

$Q = 549 \times 0.1 = 54.9$ Btu (4)

$W = P_1(V_2 - V_1)/J$
$= 74.2 \times 144(20-10)/778$
$= 137.5$ Btu per lb

$W = 137.5 \times 0.1$ lb $= 13.8$ Btu (5)

$E_2 - E_1 = Q - W$
$= 54.9 - 13.8 = 41.1$ Btu (6)

We can check this by the specific heat equation, remembering we have 0.1 lb:

$E_2 - E_1 = c_v(T_2 - T_1)0.1$
$= 0.21(3,920 - 1,960)0.1$
$= 41.2$ Btu (6)

a close enough agreement, seeing this is slide-rule computation and we are only working with three significant figures.

Constant temperature: We have 0.1 lb of 1960-°R air initially in a volume of 1 cu ft, we expand this volume in a cylinder to 2 cu ft at constant temperature. (1) What is the initial gas pressure P_1? (2) What is the final gas temperature T_2? (3) What is the final gas pressure P_2? (4) What heat Q has been transferred to the gas? (5) What work W has been done by the gas on the piston? (6) What is the change in internal energy ΔE of the gas?

As found for the constant-volume process, $P_1 = 74.2$ psia (1)

By definition $T_2 = T_1 = 1960°$R (2)

$P_2 = RT_2/V_2$
$= 54.5 \times 1960/20 = 5,340$ psfa

$P_2 = 5,340/144 = 37.1$ psia (3)

$E_2 - E_1 = c_v(T_2 - T_1) = 0$ (6)

Since the temperature stays constant.

$$Q = W = \frac{P_1V_1}{J}\log_e(P_1/P_2)$$

$= 74.2 \times 144 \times 10/778$
$\log_e(74.2/37.1)$
$= 137.4 \times \log_e 2 = 137.4 \times 0.69$

$Q = 94.8$ Btu per lb

$Q = W = 94.8 \times 0.1 = 9.48$ Btu

Adiabatic process: We again have 0.1 lb of 1960-°R air initially in a volume of 1 cu ft, we expand this volume in a cylinder to 2 cu ft adiabatically (without loss or gain of energy as heat). (1) What is the initial gas pressure, P_1? (2) What is the final gas pressure, P_2? (3) What work W has been done by the gas? (4) What heat Q has been transferred in or out of the gas? (5) What has been the change in internal energy ΔE of the gas?

As found for the constant-volume process, $P_1 = 74.2$ psia (1)

$P_2V_2^k = P_1V_1^k$

$P_2 = P_1(V_1/V_2)^k$
$= 74.2(10/20)^{1.33} =$
$74.2 \times 0.5^{1.33}$

$P_2 = 74.2 \times 0.398 = 29.5$ psia (2)

(Note: 0.398 was found by using the log tables—you can estimate this by using Fig. 3; $0.5^{1.3} = 0.407$ and $0.5^{1.4} = 0.379$. Interpolating for 1.33 you'll get 0.3986)

$$W = \frac{P_2V_2 - P_1V_1}{J(1-k)}$$

$$= \frac{144\ (29.5 \times 20 - 74.2 \times 10)\ 0.1\ \text{(lb)}}{778(1-1.33)}$$

$$= \frac{14.4(590-742)}{-256.7}$$

$W = 8.5$ Btu (3)

In an adiabatic process $Q = 0$ (4)

$W = E_1 - E_2$ since Q = 0, so

$E_1 - E_2 = 8.5$ Btu (5)

This can be cross checked by finding the temperature T_2 and then using it in the specific-heat equation:

$T_2 = P_2V_2/R$
$= 144 \times 29.5 \times 20/54.5$
$= 1559°$R

$E_1 - E_2 = c_v(T_1 - T_2)0.1$
$= 0.21(1960 - 1559)0.1 = 8.4$ Btu

This is good agreement with W for computation by slide rule.

Comparison. Fig. 5*a* gives us a graphical comparison of four different processes starting from the same state at *1*. These show that W is zero for constant V and grows progressively for the adiabatic, constant T, and constant P, when we estimate the comparative areas under the curves.

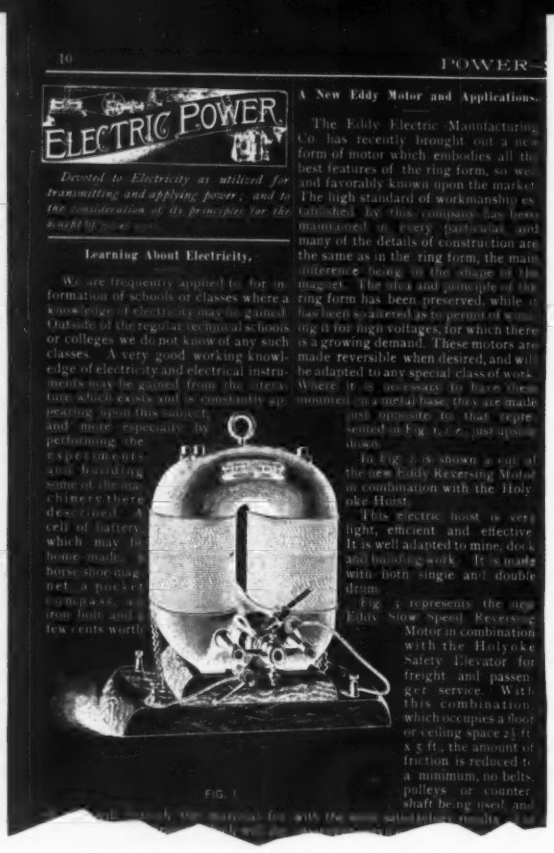
The examples we just worked out, all started from the same state and expanded through the same volume change, here's how their W's compare:

Adiabatic	8.5 Btu
Constant T	9.5 Btu
Constant P	13.8 Btu

Their Q's compare like this:

Adiabatic	0.0 Btu
Constant T	9.5 Btu
Constant P	54.9 Btu

Next part will deal with the Carnot power cycle—in a forthcoming issue.



10 POWER—

ELECTRIC POWER

Devoted to Electricity as utilized for transmitting and applying power; and to the consideration of its principles for the benefit of users.

Learning About Electricity.

We are frequently applied to for information of schools or classes where a knowledge of electricity may be gained. Outside of the regular technical schools or colleges we do not know of any such classes. A very good working knowledge of electricity and electrical instruments may be gained from the literature which exists and is constantly appearing upon this subject, and more especially by performing the experiments and handling some of the machinery there described. A cell of battery, which may be home-made, a horse shoe magnet, a pocket compass, an iron bolt and a few cents worth

FIG. 1

A New Eddy Motor and Applications.

The Eddy Electric Manufacturing Co. has recently brought out a new form of motor which embodies all the best features of the ring form, so well and favorably known upon the market. The high standard of workmanship established by this company has been maintained in every particular, and many of the details of construction are the same as in the ring form, the main difference being in the shape of the magnet. The idea and principle of the ring form has been preserved, while it has been so altered as to permit of winding it for high voltages, for which there is a growing demand. These motors are made reversible when desired, and will be adapted to any special class of work. Where it is necessary to have them mounted on a metal base, they are made just opposite to that represented in Fig. 1, *i. e.*, just upside down.

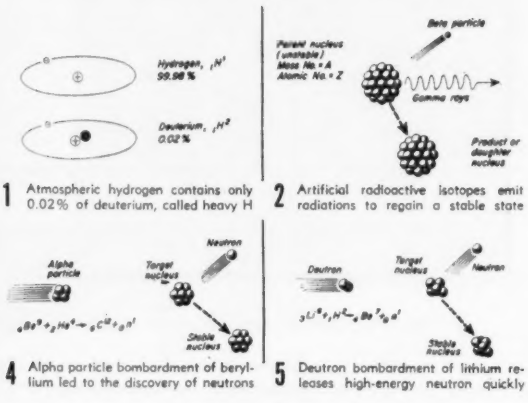
In Fig. 2 is shown a cut of the new Eddy Reversing Motor in combination with the Holyoke Hoist.

This electric hoist is very light, efficient and effective. It is well adapted to mine, dock and building work. It is made with both single and double drum.

Fig. 3 represents the new Eddy Slow Speed Reversing Motor in combination with the Holyoke Safety Elevator for freight and passenger service. With this combination, which occupies a floor or ceiling space 2½ ft. x 5 ft., the amount of friction is reduced to a minimum, no belts, pulleys or counter shaft being used, and

IN THE 1880's, power men studied the new electrical art, just as their descendants learn about atoms IN THE 1950's

NUCLEAR-ENERGY STUDY COURSE: NUMBER 5



1 Atmospheric hydrogen contains only 0.02% of deuterium, called heavy H

2 Artificial radioactive isotopes emit radiations to regain a stable state

4 Alpha particle bombardment of beryllium led to the discovery of neutrons

5 Deutron bombardment of lithium releases high-energy neutron quickly

Preparing for the future: A never-ending job

► FOR THE ENGINEER who would keep pace with an advancing profession, learning must be essentially continuous. In this day-by-day job of preparing for the future, the technical magazine plays an important part. Just how important can be seen most clearly at times of far-reaching change.

The 1880's provide a good example—and an interesting parallel with our own times at the middle of the 20th Century. In the 1880's, what might be called the "electrical revolution" was getting under way. Now we are at the beginning of what future generations may call the "nuclear revolution." With this parallel in mind, we have been studying with particular interest the early issues of POWER, launched just 75 years ago when the electrical era was being born.

From the beginning, the alert editors of the young magazine POWER kept a watchful eye on the new form of energy entering their field. They saw, and reported, early applications of electricity for lighting, particularly lighting for streets and public places. And they noted the first fumbling efforts to apply electric motors to practical plant use. In February, 1887, for example, they said:

"The transmission of power from the point of generation to the point of utilization is now occupying the attention of the most expert in the field. . . . Already motors have been designed for driving fans . . . and there is talk of making the same application to lathes and other tools. . . ."

As it became clear that electricity would give power new reach and flexibility, it also became clear that a whole generation of mechanically trained engineers would need to add an understanding of this new electrical art to their mental tool kit. So, in December 1888, POWER's editors inaugurated an "Electric Power" department. The cut above illustrates the heading used in early issues.

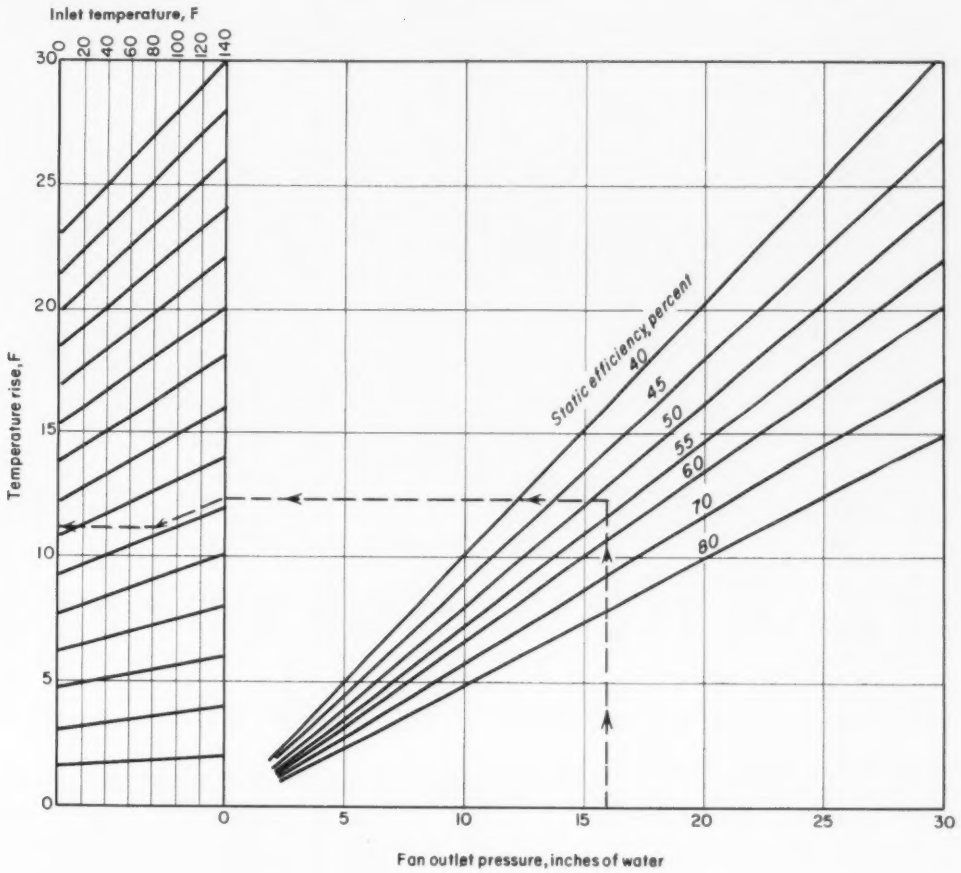
At a time when a typical issue of POWER contained some 16 tabloid-size editorial pages, the editors allocated an average of two or more to this new department. In it they reported new developments and, most important, they ran a series of educational features beginning with the famous "Electrical Catechisms." This pioneer study course developed the basic principles of electrical machinery in question-and-answer style. It was followed by another extensive series called "Electricity in the Engine Room."

As fundamentals began to be understood, emphasis shifted to practical know-how. The September 1890 issue contained the first installment of a narrative-style series called "Running an Electric Station." And by January 1892, the motor art had become sufficiently established to devote an entire department to drawings and descriptions of 28 current designs. This might be considered the ancestor of the POWER special reports of more recent years, tackling in modest fashion the same fundamental job—to give the busy power engineer, in highly condensed fashion, an up-to-date round-up of some part of his field.

We like to think that this alertness to the needs of an advancing profession has continued as a cornerstone of POWER's editorial policy. As more recent evidence, we recall the electronics series that began in April 1948, and the 19-part nuclear-energy study course concluded in the spring of 1956.

Power's DATA SHEET

No. 299



Air temperature rise through f-d fan

► WE MUST KNOW the temperature rise of air passing through an f-d fan to get: (1) more accurate boiler efficiency calculations (2) better control of steam heating of inlet air for corrosion control (3) proper calibration of station instruments for station control. Chart above quickly calculates temperature rise when knowing the outlet pressure, fan static efficiency, and air inlet temperature.

Chart is based on this formula:

$$\Delta T = T_1 \frac{\left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}} - 1}{E/100} - \left(\frac{P_v}{P_1}\right)^{\frac{k-1}{k}} + 1$$

where

ΔT = temperature rise, F

T_1 = air temperature at fan inlet (absolute), °R

P_2 = fan outlet static pressure, inches water absolute

P_1 = atmospheric pressure, fan inlet, inches water absolute

P_v = fan oulet velocity pressure, inches water absolute

k = ratio of air specific heats, c_p/c_v

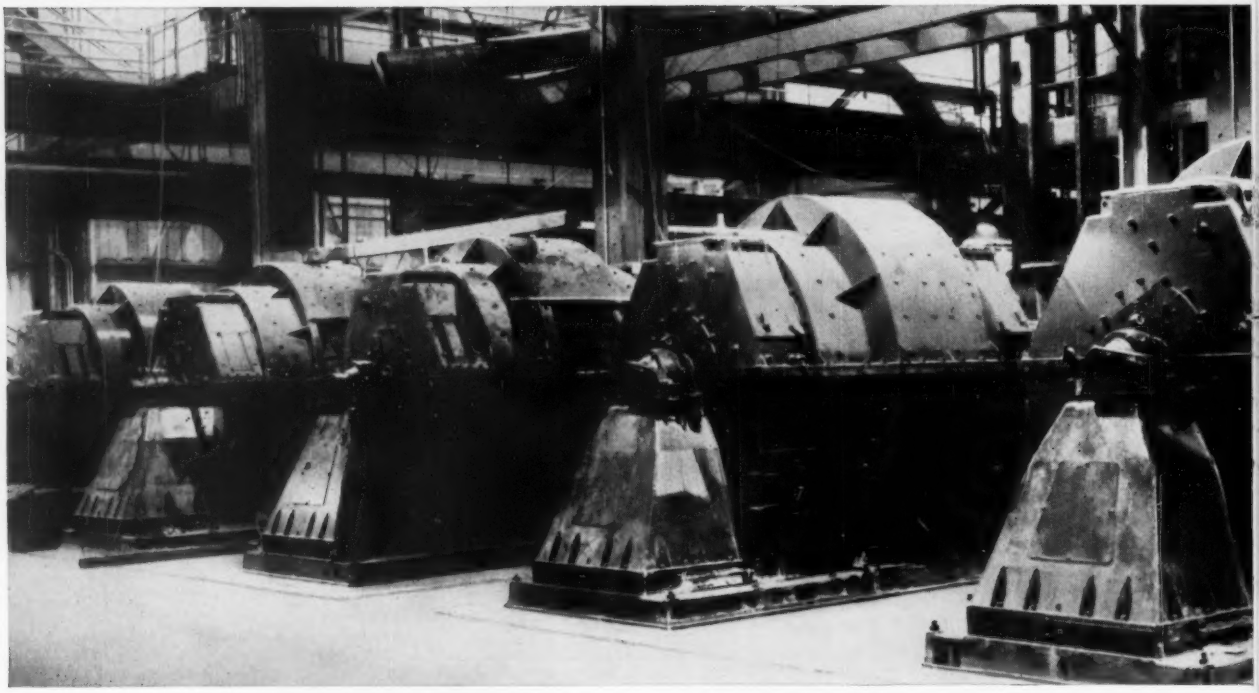
E = static fan efficiency, %

Degrees F are converted to °R by adding 460. Atmospheric air pressure P_1 equals 407 in. water; to find P_2 use in. water gage as read by a manometer and add 407. The exponent $(k-1)/k$ is taken as 0.283; and the static fan efficiency can be obtained from manufacturers' specifications.

The last factor is a small correction for velocity pressure. Assuming an average of 3500 fpm (equal to 0.76 in. water gage) will make differential temperature correct to within 0.3 F for velocities up to 5000 fpm.

CHARLES B SCHUDER, *W Lafayette, Ind.*

© POWER



Six Riley Pulverizers

Other Riley 550 Duplex Pulverizers have been installed in central stations of these public utilities.

Columbus & Southern Ohio Electric Co.
Picway — 4 Units

Public Service Co. of Colorado
Denver — 11 units

Iowa-Illinois Gas & Electric Co.
Davenport, Iowa — 1 unit

The Potomac Edison Co.
Albright, W. Va. — 3 units

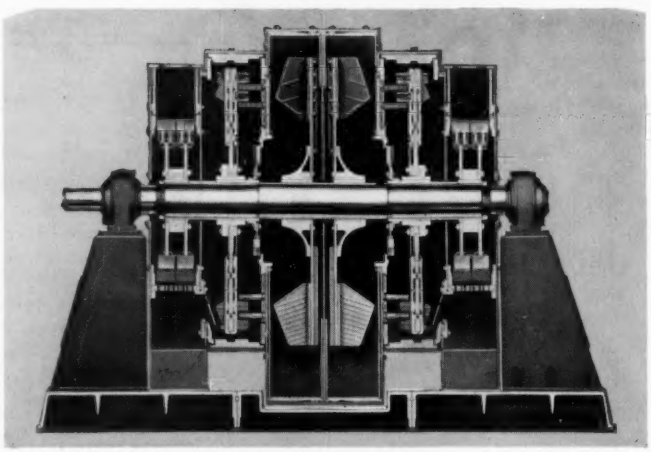
Monongahela Power Co.
Albright, W. Va. — 3 units

Delaware Power & Light Co.
Delaware City, Del. — 9 units

Iowa Public Service Co.
Waterloo, Iowa — 2 units

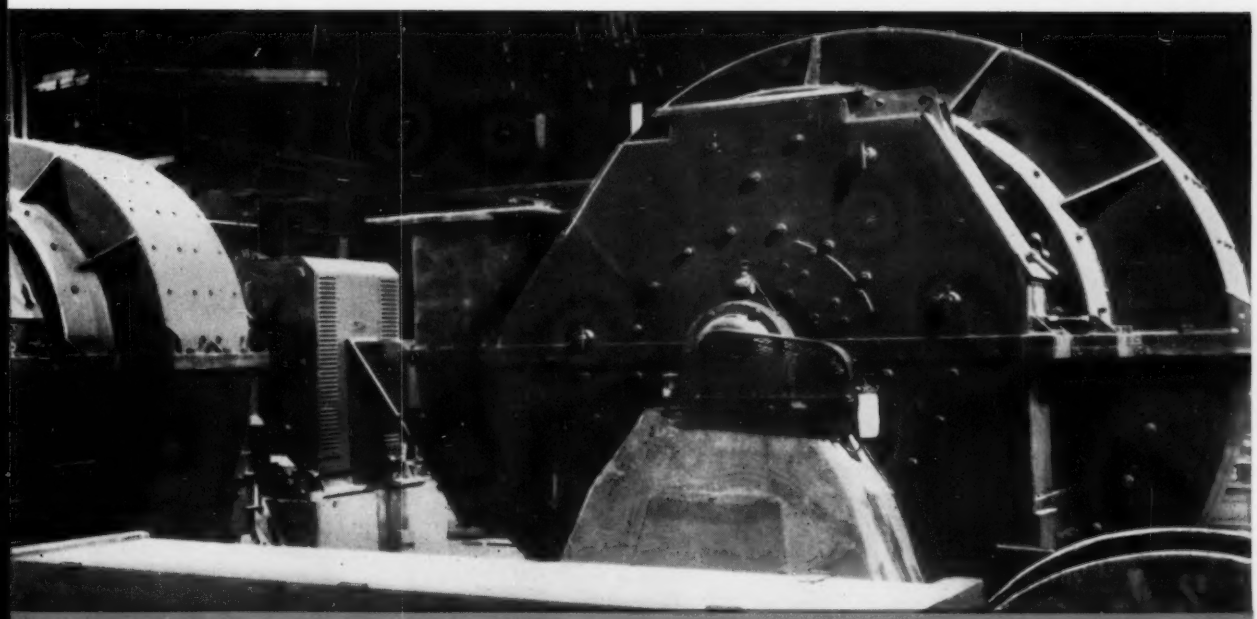
A few 550 and 450 Pulverizer Public Utility Installations

Utah Power & Light Co., Gadsby — 4 units
Northern States Power Co.,
Granite Falls, Minn. — 3 units
The Hartford Electric Light Co.,
Middletown, Ct. — 8 units
Iowa Electric Light and Power Co.,
Marshalltown — 6 units
Boone — 3 units
Taiwan Power Co., Formosa — 3 units
Upper Peninsula Generating Co.,
Marquette, Mich. — 2 units
Interstate Power Co.,
Lansing, Iowa — 2 units
Minnesota Power & Light Co.,
Duluth — 4 units



Some of the Outstanding Advantages of Riley Pulverizers

Tungsten carbide faced pulverizing parts
No metal to metal contact
Quiet, vibrationless operation
Small overall space
Low foundation cost
No loss of capacity with wet coal
Extreme load range
Insignificant Btu loss with rejections
Insignificant handling cost of rejections
Ease of maintenance and service
No adjustments required to maintain fineness
Low cost maintenance with high ash coals
Ability to use high primary air temperature with increase in efficiency
Minimum of lubricating difficulty
Ease of automatic regulation
No auxiliary air required for sealing
Minimum explosion and fire hazard
Rapid response to load change



will pulverize 115 tons of coal per hour at River Rouge Plant of Detroit Edison

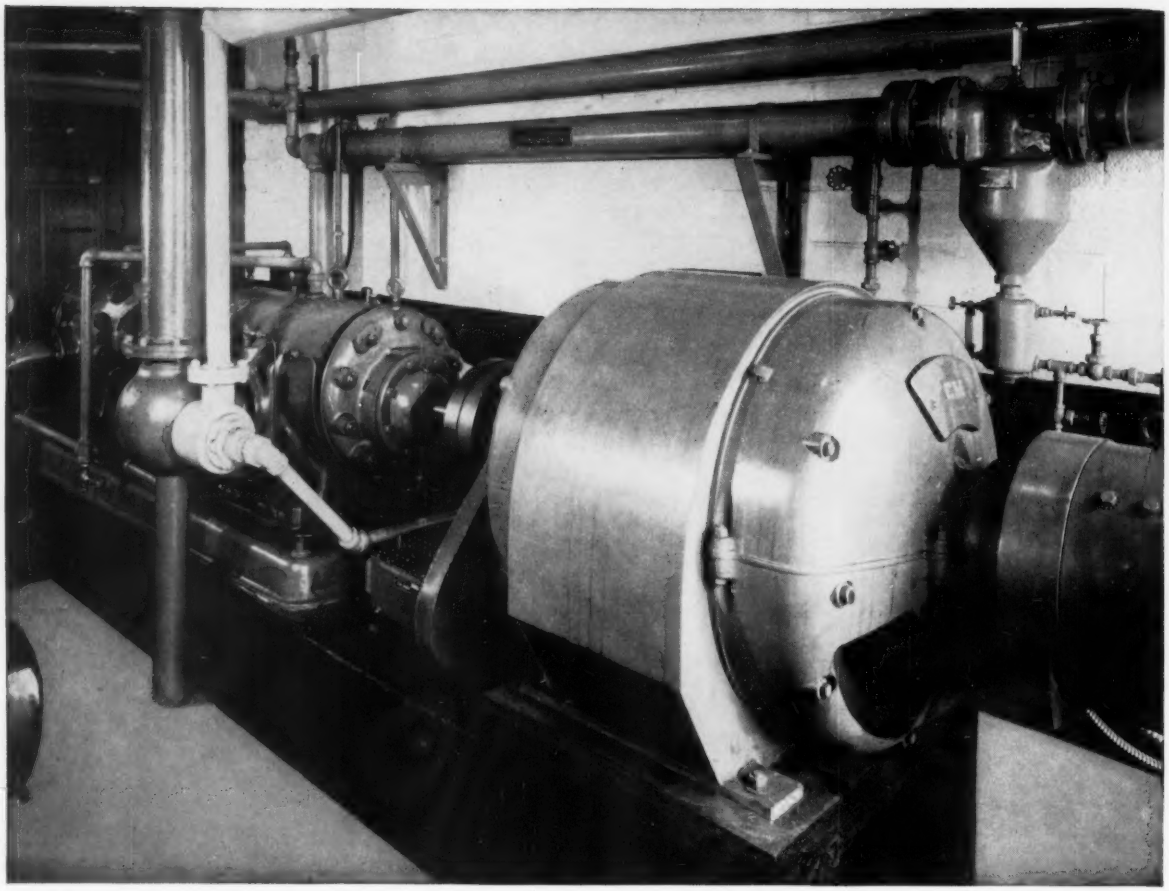
When the huge new 2,000,000 lbs/hr boiler at Detroit Edison's River Rouge Plant goes on the line these six Series E Riley Duplex Pulverizers, capable of pulverizing up to 138 tons of high fineness pulverized coal per hour, will provide more than enough capacity for the 114.5 tons per hour required by the huge boiler. Among their many desirable features will be quiet, vibrationless operation. Operating without metal-to-metal contact, pulverizing pegs, mounted on a huge rotating disc, will shatter coal particles against stationary pegs reducing coal by attrition to a high degree of fineness, and will sustain this fineness indefinitely. Tungsten carbide is applied to the facing of pegs to help reduce effects of erosion, and to prolong availability.

Riley is proud that the performance of its Pulverizer merited its selection for such an important role in Detroit Edison's expansion program, a program largely dedicated to the search for better and more efficient steam generation from coal.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.



THEY'VE ORDERED FULLER ROTARIES AGAIN AND AGAIN . . .

The proof is the record. Reading Tube Corporation bought its first Fuller Two-Stage Rotary Compressor in 1944—a C50-50H. To meet expanding pneumatic power requirements for increased production, they added a C100-100H Rotary in 1946. Again, the only and obvious choice was Fuller. In 1953, Reading Tube installed its third Fuller Rotary—a C175-175H, and reports continued satisfactory and economical operation, with a bare minimum of maintenance on all three.

Reading Tube Corp. uses Fuller compressors exclusively for such variety of needs as supplying air power in their casting shop, mill, draw benches, in testing and packing, as well as for hand accessories such as grinding, polishing, drilling, etc.

Check these advantages when your plant needs reliable air power . . . . they've made Fuller the choice, time and time again.

- . . . full capacity for life of the machine
- . . . smooth air flow
- . . . sustained performance for top capacities up to 3300 c.f.m. and pressures to 125 pounds
- . . . compactness and ease of installation, requires minimum space and light foundation
- . . . vibrationless due to absence of reciprocating parts.

To get all the facts, write today for Bulletin C-5A.

C-310
3894

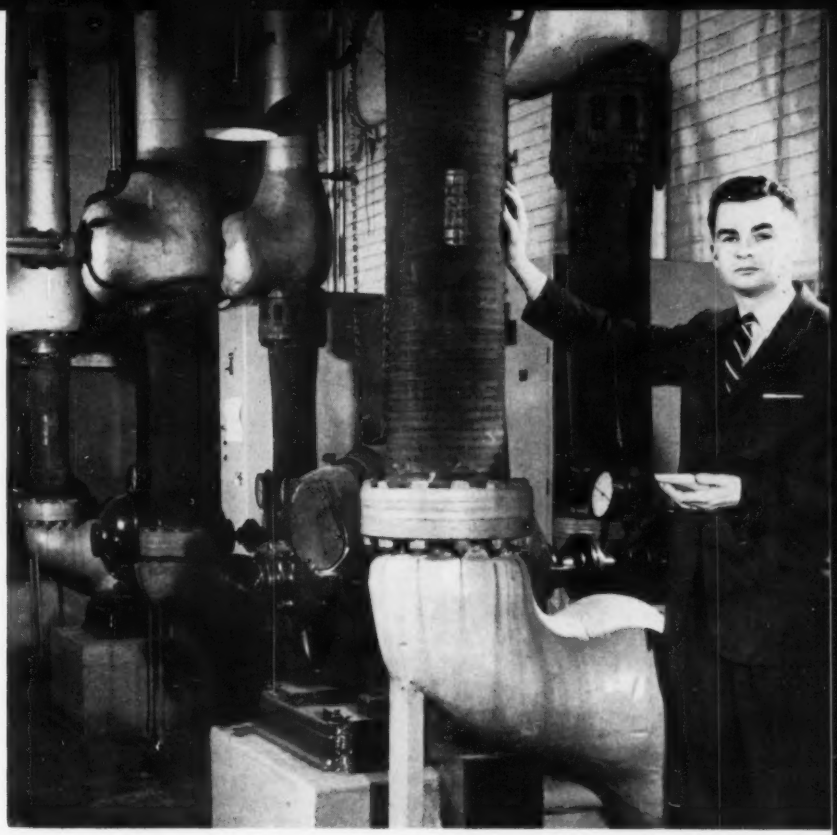
FULLER COMPANY
GENERAL AMERICAN
TRADE MARK

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Birmingham · Chicago · Kansas City · Los Angeles · San Francisco · Seattle

Fuller

PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

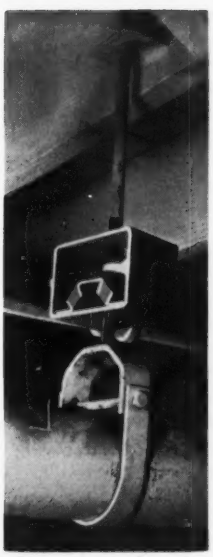
STEVE ELONKA
Associate Editor in Charge



FLEXIBLE PIPING SECTIONS in the suction and discharge lines of these chilled water pumps minimize vibration, eliminate noise and have ability to absorb water hammer

You can control piping vibration

says V V Cerami, *Chief Engineer, T R Finn & Company, Inc*



Pipe vibration hanger

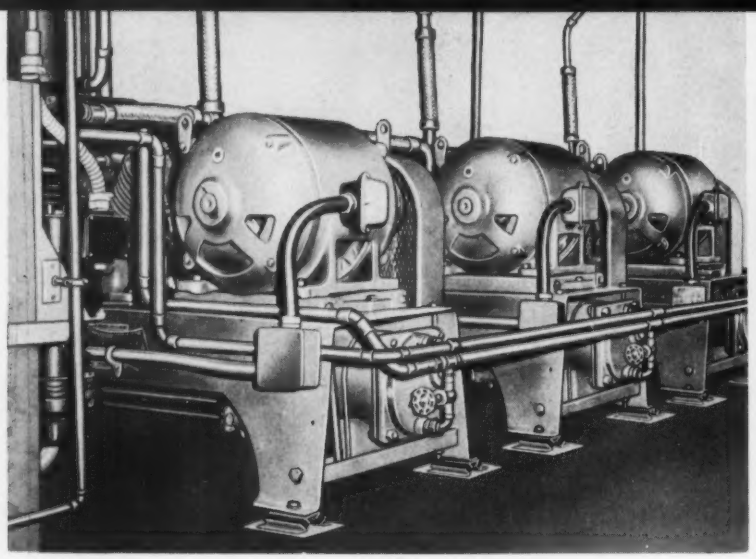
► A PIPE ORGAN is the only piping system that benefits from vibration. And the qualities creating the rich, resonant sound of the pipe organ are the same qualities that make piping systems a maintenance man's nightmare.

In other words, fluid piping systems are near-perfect conductors of noise and vibration. Because they are, a pump or compressor can be the undetected cause of a repeated valve failure at the other end of a plant. Likewise, leaky and cracked pipe joints are often caused by continuous vibration. In fact, entire piping systems have been known to fail from undetected effects of vibration. So, get into the habit of looking for vibration if you have repeated trouble with piping.

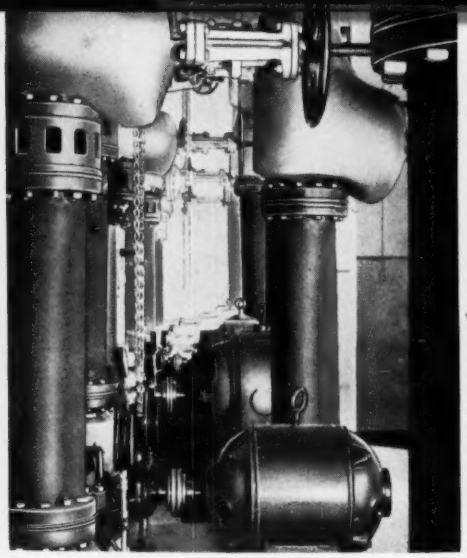
Let's consider two things: (1) source of vibration within piping systems (2) means of controlling its effect.

Generally, detecting source of vibration within a piping system is easy. It's usually caused by machines that provide the propulsive force for fluid being circulated—a pump or compressor of some sort. Compressor itself is often culprit in a compressed-air system. Equipment powered by compressed-air line—riveters, air hammers, presses and the like—may feed vibration back into the compressed-air line. But these feedback effects are usually negligible *except in immediate area.* Same is true of all types of fluid lines.

Three ways to isolate this vibration and minimize its harmful effects are: (1) Put vibration isolators under source of vibration—vibration mounts or pads under a compressor, for example. (2) Isolate piping system from source of vibration. Do this by placing specially designed short lengths of flexible piping into the line on *discharge* side of pumps and compressors. (3) Use vibration hangers as flexible anchors on piping. They offset forces set up by vibration,



RUBBER-IN-SHEAR mounts team up with seamless flexible metal sections in piping of these Freon compressors to isolate noise and dampen vibration throughout system



FLEXIBLE PIPING sections in large pump room isolate harmful noise in this plant

Noise from these machines is not carried through piping

thus minimize their damaging effect.

You can use one, two or all three methods, depending on severity of vibration and degree of isolation needed. All three methods are often used in air-conditioning systems, but a small compressed-air line may only need mounts or pads under the compressor. Now, let's look into each of these three methods.

Vibration hangers. Regular suspension hangers can't control vibration. Fact is, they transmit it from ceiling to pipe or suspended equipment, and vice versa. But vibration hangers provide both suspension and vibration isolation. There are several types to meet your varying needs.

You can often use a vibration hanger as a "trouble-shooter" because it's relatively inexpensive. For a localized problem—a valve or joint that keeps giving trouble—try vibration hangers alone. Isolate a section of pipe before and after the trouble spot by replacing conventional suspension hangers with vibration hangers. While this seems unscientific, it's fast, simple and inexpensive. And it usually solves the problem.

As a rule of thumb, same spacing and load requirements that apply to conventional suspension hangers apply to vibration hangers. When you want to isolate ceiling-suspended equipment (fans, blowers, etc) divide the total weight of unit to be suspended by number of hangers to be used. If unit's weight isn't evenly distributed, estimate the unbalance and choose your hangers accordingly. *Note:* Always be sure that hangers will continue to hold your equipment even if the isolator (rubber or steel spring) fails.

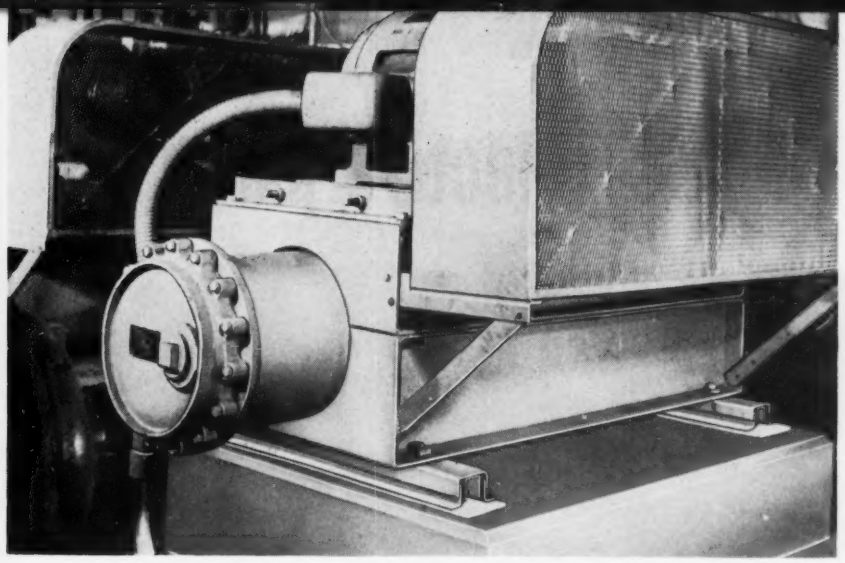
Flexible piping. Purpose of flexible piping is to reduce noise and prevent vibration transmission. It acts as a barrier to noise and vibration while allowing free passage of whatever fluid is being pumped. The closer flexible piping is put to source of vibration, the better. Three flexible-piping types are available, each for a specific job.

(1) For water lines. Most popular flexible piping for water lines is a wire-reinforced wrapped-fabric section of rubber pipe. Its low acoustical impedance reduces noise transmission. Diaphragm-like breathing action prevents water hammer. Because it breaks the rigid piping, it greatly reduces transmission of vibration. Low in cost, easy to install, these rubber pipes can be used at working pressures up to about 250 psi.

(2) Liquid and gaseous refrigerant lines are common in air-conditioning units and in general industry. Rubber

Select the right hanger for the job

Type	*Load range*	*Application*
Rubber-in-shear (flange type)	35 to 1500 lb	Best suited for general use. Bolts directly to overhead support
Rubber-in-shear (for rod suspension)	35 to 1500 lb	Designed for general use. Suspended above by a rod
Double-hung rubber-in-shear (rod suspension)	35 to 1500 lb	Double deflection gives correspondingly greater vibration isolation. Particularly good for low frequency disturbances
Steel spring (flange type)	50 to 1000 lb	Use where high or low temperatures are present, where low disturbing frequencies prevail and wherever superior isolation is needed
Steel spring (for rod suspension)	50 to 1000 lb	



FLOATING-RAIL vibration mounts have rubber-in-shear. Before installing mounts, compressor-condenser units in Argentine mint prevented correct weighing in next room

because they are isolated

pipe can't be used here, because these fluids embrittle rubber. Experience shows that best all-around flexible pipe for such jobs is a specially designed seamless flexible-bronze tubing. Pipe is encased in a protective cover of braided bronze wire. Flexible-bronze tubing is also used in (a) water lines where temperature exceeds limits of rubber pipes and (b) in lines handling fluids that attack rubber.

(3) For tough jobs. Piping systems, carrying steam, corrosive chemicals, oil and gas, or high-pressure systems present a special problem. In these cases, a stainless steel (or other alloy) welded-diaphragm packless expansion joint is best. They are for temperatures from –300 to 1800 F, and up to 1000-psi pressure. Installation is relatively simple since they are available with Van Stone self-aligning flanges or welded-end fittings.

Vibration theory. Any machine that moves sets up vibration. It has to. Rotating actions can't be perfectly balanced within a machine and eccentric motions (like stroke of a compressor) may be needed for its operation. Either action—rotating or eccentric—creates vibration. Vibration is measured in cycles per minute (cpm), a measure of how many individual vibration waves occur in one minute.

Vibration engineers call any vibration that causes trouble a *disturbing frequency*. First step in solving a vibration problem is to find your disturbing frequency. This doesn't mean that speed of main electric motor (in rpm) can automatically be converted to disturbing frequency (cps). You must multiply this rpm rate by number of reciprocating actions of equipment (if it has one, multiply by one). Here are two examples: (1) A pump is motor-driven at 1500 rpm and its impeller has six vanes. Total: 1500 times 6 = 9000. Thus 9000 is the disturbing frequency here. (2) Two-cylinder compressor operates at 600 rpm, makes two strokes with every revolution. Total: 600 times 2 = 1200. Thus 1200 is disturbing frequency here.

Isolating vibration. Once you know disturbing frequency, you can start isolating it. Vibration can be isolated by mounting equipment on a resilient base so its natural frequency becomes much lower than disturbing frequency. Lower the natural frequency of the mounted equipment, more effective the vibration isolation. For average problems, disturbing frequency should always be at least 2½ times natural frequency. For critical jobs (where vibration disturbs lab instruments, for example) make ratio four to one or more.

Are you wondering how this can work when you don't know how to find the natural frequency of a mount? That's simple. Natural frequency of vibration mounting under load depends upon characteristics of mount itself. Also upon weight it supports. There are formulas, but forget about them. Every maker of mountings will give you load range and natural frequency data on their mounts. That's all you need.

To review follow these steps: (1) Determine disturbing frequency of equipment that's giving you trouble (2) Study manufacturers' catalogs. Pick a mounting whose natural frequency (within proper load range) will be low enough to give you (a) ratio (disturbing frequency: natural frequency) of at least 2½ : 1 for average cases or (b) ratio of 4:1 for critical cases. So much for theory. Now let's see how it's practiced.

Ana'yze equipment to be isolated. Knowing what *not* to do is important. Don't attempt to solve a complex problem—a large compressor or very heavy pump, for example — without expert counsel. A large compressor presents a tricky problem. Its center of gravity is high, and its long stroke creates intense longitudinal shocks. At times, custom cement blocks must be floated in foundation to offset this type of problem. As a rule of thumb, these concrete blocks, should be at least 1½ times equipment's weight. This lowers center of gravity, increases the mass, decreases unit's natural frequency.

Usually two types of mountings are recommended for average use. It's these that will interest you most. One is the spring-type mount; other is rubber.

Steel-spring mountings are more expensive than rubber mounts but have many advantages: (1) usually have lower natural frequency than rubber mounts, thus can be used for lower-speed machinery (2) handle heavier loads (3) require less space (4) retain properties in both high- and low-temperature applications.

When specifying a steel-spring mount make sure it does some damping or it will bounce like a car with bad shock absorbers. Also, check it for some sway control to prevent equipment from swaying on its mounts.

Rubber vibration mounts are less expensive than steel-spring mountings, and in many cases very satisfactory. But don't use rubber for extremely heavy machinery, low-speed machinery or where there's high- or low-ambient temperature or exposure to oil or ozone.

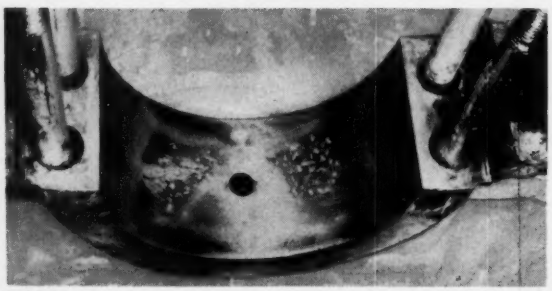
I recommend a rubber-in-shear isolator rather than rubber in compression. Rubber-in-shear has a low natural frequency, thus is a better isolator.

Other materials and methods. Besides cork and felt, a great variety of composition pads are used for vibration isolators under machinery. These pads and materials do a very good job on machines having a high center of gravity. They are also well-suited for massive machinery. A final advantage of composition pads is their low cost.

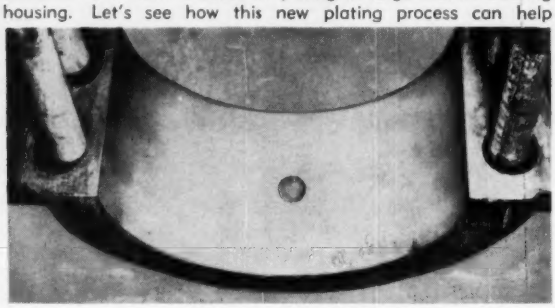
OPERATORS' NOTEBOOK 108

Here's selective plating:

EQUIPMENT needed for job is special rectifier that changes 110-volt ac line current to dc, two leads and plating solution



BEFORE. Corrosion is cause of pitting in large marine bearing housing. Let's see how this new plating process can help



AFTER. Plated bearing is better than new because of its alkaline nickel and tin coating of 0.0005 inch for wear protection

Now this 'putting-on' tool plates metal where you need it

► REPLACING WASTE METAL caused by wear, erosion, arcing, fretting corrosion, faulty machining is a big maintenance headache. But now you can build up the exact amount of metal needed by plating—on the exact area—and do it with this portable unit that needs no costly plating tanks.

Circuit breakers, for example, normally wear only on contact surfaces where arcing causes surfaces to pit, blacken and burn. Sooner or later you must rebuild these areas. Plating them with a rhodium which is highly arc resistant and has good electrical conductivity, is a good bet. But this metal is very expensive. If you use conventional plating techniques you'll deposit much of this precious metal over the breaker arm, mostly where it's not needed. Selective plating with this new process is your answer.

Fretting corrosion, one of the biggest headaches with roller-contact bearings, can now be avoided by this process. Use these new techniques and materials to get a tight uniform fit between bearing rings and housing or shaft. Then, even under severe vibration, the bearing will remain in place; won't seize the shaft, cause galling or other damage.

Precision fitting means a thin deposit of a soft metal on outer surface of bearing rings. This causes the metal to (1) conform during press fitting or (2) compress in a shrink-fit and completely fill the space between the bearing and stationary machine member. Four metals have been found best for this work—tin, cadmium, copper and silver. Tin is most practical.

Known as the Dalic process, it uses a special rectifier to change 110-v ac line current to direct current. Voltages may be varied with a continuously variable voltage control. Two leads go to rectifier: a cathode, clamped to workpiece, and the anode, to which a special plating stylus is fitted. Either a plug-type or cap-type stylus is used, depending on the size and shape of the area to be plated.

Cover the stylus with cotton, then saturate cotton swab with the plating (or cleaning) solution. These plating solutions are basic, rather than acidic as most electrolytes. Thus they aren't harmful to the skin and have no noxious vapors. Also, solutions evaporate slowly, so you can keep them in an open dish while using. Solutions are available for plating almost any metal.

The process is fast since you only have to plate the section that actually needs protection—not the entire part. No plating tanks are needed. You can deposit one metal, then a totally different one, merely by changing the electrolyte and the stylus, or the cotton swab on the stylus. Thus, you can handle many maintenance jobs with a small investment.

Thickness of deposit is controllable within 0.0001 in. with a finely graduated ampere-hour meter. Just continue to plate the area until the previously calculated ampere-hours have been achieved. There's no danger of shock or overload, as relay shuts off machine long before there's any chance

another new maintenance tool

By STEVE ELONKA, *Associate Editor*

HARD NICKEL and chromium flash replaces the lost metal on this splined shaft

BUILDING UP roller bearing for press-fit—protect the rollers from electrolyte

VIBRATION-PROOF fit for roller bearing housing is assured with tin plating

of dead short or base metal burning.

Another advantage: Much higher current densities are used. What does this mean to you maintenance men? It gives better adhesion to base metal and denser deposits, results in repairs that will last longer.

Where can you use this process? Burned electrical contacts, corroded shafts, mismachined parts, loose-fitting bearings, poorly conducting electronic equipment are only some of many uses.

Precision-fitting bearings is a natural for this process. Wherever possible, plate the housing to thickness shown in data supplied with equipment. If this is feasible, you may build up the bearing itself. But you must protect the bearing races so no solution enters to destroy their accuracy.

Case history. An ocean-going tanker recently had fretting corrosion trouble with one of its main bearing liners. Normally, the liner had a little lateral play for flexible bearing action. But because of constant vibration, some metal on outside of liner had worn away. That caused greater stress areas on sections where metal was still intact. This, in turn, brought on still more fretting corrosion. Finally the entire liner was literally welded to the main bearing support, causing the shaft to heat excessively. It was feared the shaft would crack.

Problem was licked by depositing an anti-fret coating on the liner, without regrinding either the liner or the main bearing housing. First, the engine bearing, steel liner with an integral section of bearing metal, was removed. Liner shell OD was cleaned with an emery slurry to remove all traces of oil or grease and rinsed in clear water.

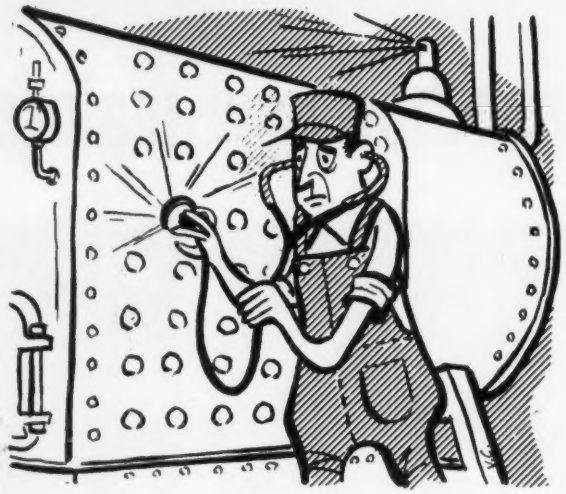
Next, plating equipment was used to clean the bearing electrochemically with a special cleaning solution and to flash-plate the liner with gold. Finally, 0.0002-in. plating of silver was deposited. Between each of these steps, liner was rinsed with clear water and rubbed down with fine levigated alumina. This gave best possible adhesion of silver plate and preceding layers.

Only two-thirds, or central 120-deg arc of bottom liner was treated. That was the area supporting most of shaft's weight. Job took about 2½ hours, not including time needed to remove liner and reinstall it. But, judging from previous experience with a similar engine, coating the liner with an anti-fret self-burnishing coat of silver will keep engine running without further trouble. This engine previously developed bearing trouble about three times a year.

Selective plating is very handy when an exact deposit of almost any metal is needed in a given area. Or when part to be repaired can't easily be removed for immersion plating.

Another big advantage is that no overplating and machining is needed to obtain exact dimension. Putting on metal is only one operation. Cost of equipment needed for selective plating is reasonable. Any skilled maintenance man can get good results after a short time.—*Courtesy, Marlane Development Co, Inc, New York, N. Y., and Dalic Metachemical Ltd, Toronto, Canada.*

Have you examined your boiler lately? Regular inspection is best way to prove effectiveness of feedwater treatment. Check your water program with help of these . . .



22 Q & A's on today's feedwater treatment for packaged boilers

By R H MARKS, *Assistant Editor*

1 How do packaged boilers differ from designs?
A Most packaged boilers are merely modifications of conventional designs. But, since they are completely fabricated before shipment, installation is quick and easy. Large amounts of steam are produced with equipment of comparatively small physical size. This calls for relatively high heat-transfer rates and high steam-generating area per unit of packaged-boiler volume. Water holding capacity is much smaller than conventional boilers.

2 Do packaged boilers need high-quality feedwater?
A Packaged boilers don't require higher quality feedwater than conventional boilers run at equivalent ratings. But clean boiler surfaces are more critical when operating at high evaporation rates. Scale builds up at a more rapid pace. Smaller steam space promotes priming and foaming. Therefore treatment must be carefully selected and controlled to produce high-quality feedwater. Don't compare packaged boilers to older steam-generators run at much lower ratings. These units sometimes do get by with minimum attention to feedwater treatment.

3 What is the first step in any water-treatment problem?
A Analyze the water. Chemically pure water is rare. Few water supplies are suitable for domestic or industrial use without treatment. And chemical composition of different water supplies vary greatly. So it is impractical to prescribe any one ideal treatment. The water must be completely analyzed before treatment can be sensibly chosen.

4 What are the basic aims of feedwater treatment?
A Basic aims are continuity of boiler service, maximum boiler and thermal efficiency and minimum maintenance charges. Chemical composition of makeup, boiler water and condensate returns must be carefully controlled.

5 How many treatment methods are available?
A There are many methods available. All come under three broad classifications—mechanical, heat or chemical treatment. Mechanical treatment includes filtration and boiler blowdown. Heat treatment includes makeup distillation and steam purification. Distillation is limited to boilers with small amounts of makeup. Steam purifiers are used where the process demands very dry steam. Chemical treatment, both internal and external, is most widely used. External treatment adjusts raw-water analysis before entering the boiler. Internal treatment adjusts boiler-water analysis by feeding chemicals directly to the boiler.

6 What is major treatment problem with heating boilers?
A Corrosion or pitting is the main problem. Scale is not a problem because the same feedwater is used continuously. Initial treatment is usually good for the entire year.

7 Why does boiler feedwater with high percent of makeup magnify the treatment problem?
A Often live steam cannot be returned to the boiler as condensate. Makeup water is added in its place. When steam is formed, any solids present in the feedwater remain behind in the boiler. Every gallon of makeup water gradually increases the concentration of the boiler water.

8 Is a small amount of scale formation harmful?
A Scale causes localized overheating that can seriously damage your boiler. It definitely impairs heat transfer. Here's what scale does to heating efficiency.

Thickness of scale inches	*Percent loss of heat*		
	Soft carbonate	*Hard carbonate*	*Hard sulfate*
1/50	3.5	5.2	3.0
1/32	7.0	8.3	6.0
1/25	8.0	9.9	9.0
1/20	10.0	11.2	11.0
1/16	12.5	12.6	12.6
1/11	15.0	14.3	14.3
1/9	—	16.0	16.0

9 How is scale prevented?
A Scale-forming ingredients are calcium and magnesium which form carbonate and sulfate scale when heated in the boiler. It can be prevented by external zeolite softening of makeup plus supplementary phosphate treatment in the boiler. Internal treatment can carry the full load if ex-

ternal softener is too costly. Phosphate precipitates calcium and magnesium phosphate, a nonadherent sludge, removed by blowing down the boiler. Soda ash, sodium aluminate, sodium silicate and various organic chemicals are also used to prevent scale.

10 Why are dissolved gases important?

A Dissolved oxygen is the chief cause of piping and boiler corrosion. Carbon dioxide, in combination with oxygen, greatly increases rate of corrosion. Oxygen and carbon dioxide carried over with the steam are dissolved in the condensate to cause return-line corrosion.

11 What is the difference between fireside and waterside corrosion?

A Fireside corrosion usually occurs in summer when the boiler is not in use. Look for concentrated pitting along bottom of firetubes or a general thinning of metal at the entrance of direct tubes. Damage is caused by sulfuric acid, formed by reaction of moisture and sulfur on carbon or soot-covered surfaces.

Waterside corrosion oxidizes the boiler metal forming pit marks or holes in the tubes. Examine for small mounds of powdered black iron oxide along the top and sides of tubes. Concentrated pitting takes place there.

12 How do you combat corrosion?

A Prevent fireside corrosion by keeping fire surfaces clean and dry during any boiler shutdown. Waterside corrosion is generally treated chemically. Sodium sulfite is very effective. It combines readily with oxygen to form sodium sulfate. Hydrazine and organic chemicals are also used. Filming amines and ammonia combat return-line corrosion.

Oxygen and carbon dioxide can also be removed by deaeration. But most small installations cannot justify the cost of equipment. A small packaged deaerator for this service is not yet available. Larger installations, or those where percent makeup is high, can often justify deaeration.

13 What is priming and foaming?

A Priming is the discharge of water slugs with steam caused by violent bursting of steam bubbles. Causes include high water level, boiler overload, highly concentrated boiler water and dirt or oil in water.

Foaming takes place on the surface of the boiler water. Causes include finely divided suspended matter and high boiler-water concentrations.

14 Foaming and priming—How is it prevented?

A Assuming that boiler is properly designed, check for possible overload. Next see if steam separator is working. Then analyze boiler salines for alkalinity and total dissolved solids. Use blowdown if solids are too high. If alkalinity is too high, reduced feed of caustic may be the answer. Antifoam chemicals will help prevent foaming.

15 Is embrittlement a problem?

A Embrittlement or intercrystalline cracking of boiler metal causes damage that's expensive to repair. It may mean replacing whole sections of the boiler. Many feel that excess boiler-water caustic is the cause. To prevent this, maintain recommended ratios of sodium sulfate to alkalinity in the boiler. Compounds containing nitrate, lignin or tannin are often helpful.

16 What are boiler compounds?

A Compounds are chemicals used for internal treatment. Organic and/or inorganic materials are compounded into liquid, paste, solid or powder form. Common ingredients include: bark and wood extracts, starch, agar, flaxseed, gelatine, sodium silicate, sodium hydroxide, sodium phosphate, soda ash and sodium chromate. Plant operators find them a real asset in feedwater treatment. Standard compounds are available in easy to handle form for almost every feedwater problem. Operators' job then boils down to feeding recommended amounts according to routine control tests.

17 How are compounds fed to the boiler?

A Method used depends on feedwater cycle, amount of makeup, and boiler pressure. Cost of feeding equipment is also a factor. Chemical solution is often pumped into the boiler drum distribution line. When makeup is low, pump can be operated manually at regular intervals or automatically on a timed cycle. Where the makeup is high and control more critical, use a pump arranged to automatically feed chemicals in proportion to boiler makeup flow.

Pressure solution feeders or pot type feeds are often used where accuracy of feed is not critical. Chemical can also be added in batches to heater or hot well if care is taken to avoid deposits in feed lines to the boiler.

18 What external feedwater treatment is commonly used?

A External treatment usually has a place where the percent makeup is high. Some installations use a zeolite softener supplemented by internal treatment. Other boilers require more elaborate treatment. Newest method is salt regenerated anion dealkalizer following zeolite softener. Alkalinity is reduced by exchanging bicarbonates and sulfates for chlorides. Effluent has about 15 to 30 ppm alkalinity.

If water supply is turbid and contains bacteria, a packaged type coagulator is the answer. Follow this unit with filters and zeolite softeners.

Demineralizing process may be called for if the boiler pressure is unusually high. High makeup may also call for its use. But this equipment is expensive compared to other treatments and regeneration requires acid and caustic handling. So, although its use for the packaged-boiler field is limited, keep it in mind when you *do* need high-quality solids-free water.

19 What maximum total dissolved solids is allowed in the concentrated boiler water?

A Most packaged boilers allow from 1000 to 3500 ppm. Actual figure for a given job depends on the type of boiler, operating pressure, percent makeup and makeup analysis.

20 How do you estimate amount of blowdown?

A Blowdown is about equal to total-dissolved feedwater solids divided by total-dissolved boiler solids, usually expressed as a percentage of the total feedwater flow.

21 Blowdown—How often?

A Blowdown low-pressure heating boilers very intermittently to remove sediment from bottom of the boiler and lower boiler solids during startup. Since there is no makeup, the blowdown valve should seldom be used.

Regular blowdown schedule is needed for high-pressure boilers and those with high makeup. Frequency depends on rate of boiler operation, amount and analysis of makeup.

22 Who supervises the feedwater treatment program?

A Boiler-water treatment involves more than just scale prevention. Kind and control of chemical treatment, regulating preheating and pretreating of makeup, regulation and control of boiler blowdown to keep right boiler-water solids are all just as important. Supervision and control of this program calls for a qualified operator or a firm specializing in boiler-chemical service. Prevention of feedwater trouble usually costs far less than the repair of neglected equipment. Final proof of any feedwater program is to observe its effect on the boiler waterside. Make internal boiler inspections a regular part of your routine maintenance program.

MAINTENANCE FOREMAN Al Iacullo discusses temperature-indicating crayon method of trap testing with field engineer.

Something new in trap maintenance

By R C BELLAS, *Assistant Editor*

► ONE BIG PART of a POWER editor's job is to get around and talk to people in the power-services field. Not only to see what's new in design and development, but to ferret out any new cost-cutting ways of doing some of the run-of-the-mill plant maintenance chores.

Scouting the field a while back, gathering material for a steam trap maintenance article, I dropped in to see Bob Jones of Advance Engineering Co. Bob is a manufacturers' agent who handles a top-flight line of traps, among other things. He gets into a lot of plants and I figured he'd be able to steer me to an engineer who had worked up some new wrinkles in trap maintenance.

While we talked, Bob fiddled with a temperature-indicating crayon lying on his desk. I knew what it was but, for the moment, didn't give it a second thought. As we talked about checking traps with stethoscopes, contact pyrometers or valved connections to make sure they weren't blowing through, I began to wonder about the crayon.

I asked Bob where he'd gotten it. He told me he'd picked it up in a welding supply shop and found it came in handy now and then in his work.

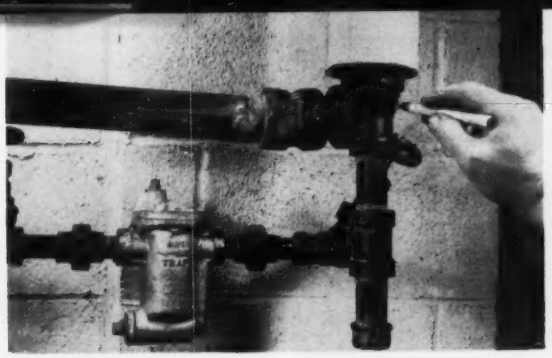
Crayon's function is to indicate metal temperature at any predetermined point. It's accurate within $\pm 1\%$ of rated temperature and is as easy to use as falling off a log. Rub the crayon against a work piece before heat is applied. When metal reaches a certain temperature the chalky mark turns to a liquid smear. The color change doesn't mean anything since melting is the determining factor.

The crayons are old hat to people in welding shops, foundries, etc, where knowing metal temperature at any given time can be a mighty important factor. I thought of the hundreds of times I'd used them to check preheat and stress-relief temperatures during the years I'd been associated with fabrication of ASME *Code* welded piping and pressure vessels.

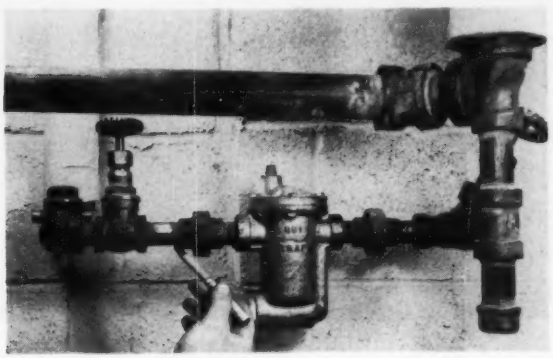
Since the crayons will detect a slight temperature change, I reasoned, why wouldn't they be ideal for spotting faulty traps? They're dirt cheap, can be carried as easily as a pencil. A man could check trap operation in a jiffy by putting a crayon mark on the trap discharge piping. If the chalk melted, the trap needed attention. If the chalk didn't melt, the trap was OK. Further, if the chalk mark was there next time he came around, he'd know the trap was on the job, just by looking at it. In addition to saving time, the method could eliminate a lot of potentially hazardous crawling and climbing.

Crayons are available from 113 to 2500 F, in increments of about 13 F, so they could be used even on low-pressure or vacuum heating systems.

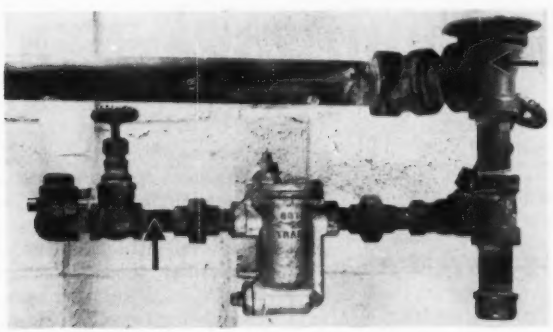
The more Bob and I talked about it, the better it sounded. Next step was to put the crayons to the test. Calling in Bud Croes, one of his field engineers, Bob told him the story and Bud jumped right on the bandwagon. He said he'd take a pocket-full of crayons, spot them in half a dozen plants at random and get the plant engineers' reaction to the idea. We especially wanted to know how the crayons would perform on traps that were designed to discharge condensate at steam temperature.



STEAM TEMPERATURE at trap inlet turns crayon's chalky mark to liquid smear. Chalk melting, not color change, tells tale



TRAP IS WORKING. Note crayon mark hasn't melted on discharge side. Theoretically condensate discharges at steam temp



TRAP IS BLOWING. *Lower arrow,* discharge side, shows melted mark, means same steam temp here as at inlet, *upper arrow*

Theoretically, there's no temperature drop across these traps. But, in actual service, there's usually enough radiation loss to produce a slight differential when the trap is working. In addition, even though discharged condensate is very close to steam temperature, the picture changes about a foot downstream from the trap. Here, some condensate has flashed, lowered both pressure and temperature. It's generally agreed that, at this point, pressure is approximately equal to 50% of trap inlet pressure, with corresponding drop in temperature. This holds true regardless of whether the trap is working on either saturated or superheated steam.

If the trap is blowing, however, this differential doesn't exist—at least not within this downstream distance from the trap.

Our test pattern was to use a crayon having a temperature rating roughly equal to 50% of trap inlet pressure and mark the piping about a foot or so downstream from the trap. (For example, assume a trap working on a 100-psi line. Inlet pressure of 100 psi would have a corresponding temperature of about 338 F. At downstream marking point, a 50% pressure drop would mean 50-psi steam with corresponding temperature of about 298 F. Crayon to use would be one having rating nearest 300 F, which would immediately melt if trap was passing 338 F steam.)

Results were better than we'd hoped for. Bud Croes reported back that, of all the traps checked, the crayons never failed to pick the bad ones. In addition, the plant engineers thought it was a pretty slick way to do the job.

Next step was to put the crayons in a different group of plants and have the engineers check the crayons' effectiveness and efficiency against any method of instrument they were using.

Again we got nothing but good reports on the crayons' performance. Quick, accurate and easy to use was the general opinion.

I wanted some photos to go with the story, so I phoned Neil Koop, plant engineer at Gering Products Inc, a plastics manufacturer in Kenilworth N. J. Process temperatures are critical in this work and Neil had been very helpful when we needed his plant to act as one of our more important guinea pigs. His maintenance foreman, Al Iacullo, who had supervised crayon testing for us, told us that he'd been using the crayons for some time to check extrusion equipment temperatures, but had never thought of using them for trap testing until we came along. We told him that he had a lot of company —none of us had thought of it before, I guess. Just one of those cases where we don't see the forest for the trees.

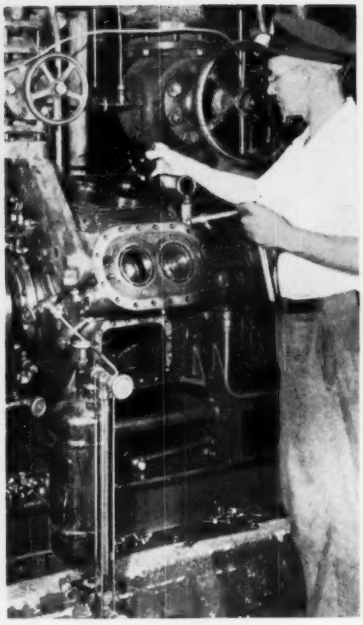
Like everyone else, Al was enthusiastic about the time and effort saved by checking traps with the crayons, told us that he'd put away the instruments he'd formerly used.

Incidentally, other engineers now tell us they're using the crayons for other jobs aside from trap testing. Motor and engine bearings, diesel-engine exhaust, electrical bus sections—anywhere they want to know if there is, or has been an undesirable temperature change. One man says he marks his fuel-oil heater discharge piping. If the mark *doesn't* melt, he'll know he is not getting good heat transfer and the heater probably needs cleaning. There are likely to be many other applications that plant engineers will think of.

So we got the pictures you see here, and here's the story. If any readers have used the crayons for trap checking, and our idea isn't original after all, our only regret is that we didn't hear of it. We'd have put the story in our next issue.

If you try these crayons in your plant and come up with any new uses that'll do a job cheaper or faster, we'd like to hear from you. We'll be happy to pass the news along to POWER readers. Everyone's interested in money-saving ideas for plant maintenance.

SERVICE SPECIALISTS stock spare parts . . .



maintain compressors . . .

Should you invest in an

What preventive maintenance prevents

An investment in an air-conditioning maintenance contract is really an investment in a preventive maintenance program. You commit yourself to the contract because you want to prevent system breakdown, avoid the financial and other losses that may result from such a breakdown. You've figured that these potential losses outweight maintenance contract costs.

Losses may take the form of perishable inventory lost, trade lost to competition, reduced employee efficiency or outright loss of manhours if you send employees home during a breakdown.

Suppose an unnoticed Freon leak is the culprit. (Regular check that comes with a maintenance contract would have picked this up.) A 1000-lb charge for a 100-hp system, at roughly 50c per lb could mean a $500 loss in refrigerant alone.

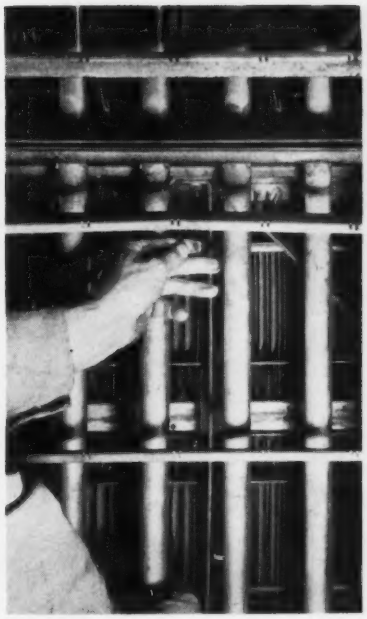
Preventive maintenance also keeps your equipment from deteriorating, actually extends its life. Over the years, parts subject to wear and tear will have been replaced, before they've had a change to do permanent damage.

► YOU'VE JUST INVESTED a sizable amount of money in a spanking new air-conditioning system and it's running fine. Maintenance is probably the farthest thing from your mind at this point. Then, along comes the air-conditioning service engineer and asks you to consider making an investment in an air-conditioning maintenance contract. Maybe your first reaction is to turn "thumbs down" on the idea. But hold on. Let's see what he has to offer.

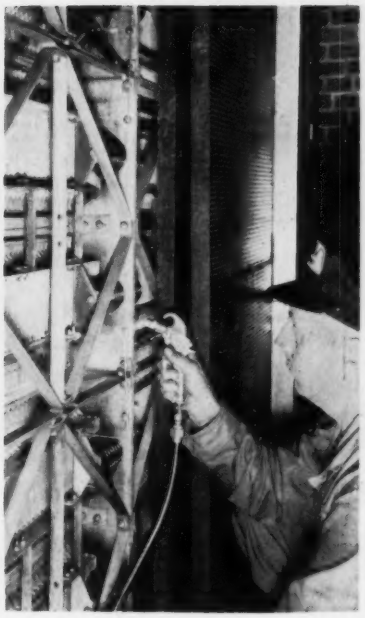
Suppose you decide to go it alone—using your own maintenance men. You must face up to several problems: (1) How to train skilled maintenance men. (2) How to keep these men abreast of latest maintenance practices. (3) How to make most effective use of a skilled mechanic's time when only part of that time is required for air-conditioning maintenance.

Size and complexity of your installation have a great deal to do with whether it'll pay you to hire your own full-time maintenance men. Naturally, few 50-hp system owners can economically justify employing full-time qualified refrigeration mechanics. But size alone can be misleading when it comes to judging the maintenance needs of

balance air flow...



adjust filters...



spray filters

air-conditioning service contract?

a system. Many 500-hp systems are less complex than 100-hp systems. And complexity is your best yardstick when it comes to forecasting the demands that are likely to be imposed by the system on the skills of your maintenance men.

One possible solution to your problem: Call in an outside service contractor as troubles arise. But, although you'll be getting the benefit of experienced full-time service men, this approach doesn't always pay off. Here's why:

(1) The outside contractor has no personal or financial interest in the installation or the business it serves.

(2) While hiring a service contractor generally brings skilled men to work on your maintenance problem, you often get no guarantee against future breakdown. And financial responsibility is still your headache.

(3) Time-and-material charges for maintenance can run high. And they may vary substantially from year to year.

(4) You aren't actually getting a planned preventive maintenance program. Thus you've got no assurance that you're getting your money's worth.

By L D SMITH

Supervisor, Maintenance Contracts
York Corporation

To fill the gaps in both of these approaches (Hiring your own men or calling in a service organization as needed), more air-conditioning service and contracting firms are offering equipment users regular plant maintenance programs. Men carrying out these programs are doing maintenance on a full-time basis. They live with problems like yours all the time. And they know the latest techniques. So they do the job right, at minimum cost to them *and* to you.

You generally buy these programs as a contract. The service man knows your equipment. And he establishes the minimum number of inspections to be made annually, in line with the needs of your units. He also spells out the maintenance checks to be made at these inspections.

The most complete kind of preventive maintenance contract offers not only inspection, oiling and adjustment of the machinery but also calls for furnishing and installing all repair parts, refrigerant, oil, supplies and even emergency service needed to keep the plant in top condition.

An alternate form of preventive maintenance contract covers inspection, adjustment and oiling of machinery, together with furnishing of some minor supplies. In addition, the more complete forms of this type of contract include emergency service. But when the service man spots troubles that require major repairs, he reports these to you, gets your OK to make the repairs on a time-and-material basis.

If you still have some lingering doubts about the value of a service contract, here's the experience of one big user. A large chain store recently closed one of its stores in which the air-conditioning equipment was 18 years old. The equipment (operating under a service contract) was in excellent condition, so the owner just removed it and reinstalled it at another store, saving him the cost of a new system. And this owner knew that he would be wasting time and money unless the equipment had many years of trouble-free life ahead of it.

Will a service contract extend unit's life so much that it becomes obsolete

SPECIALISTS test h-p receiver joints...

adjust controls...

clean evap-condenser spray nozzles...

set chemical feed rate

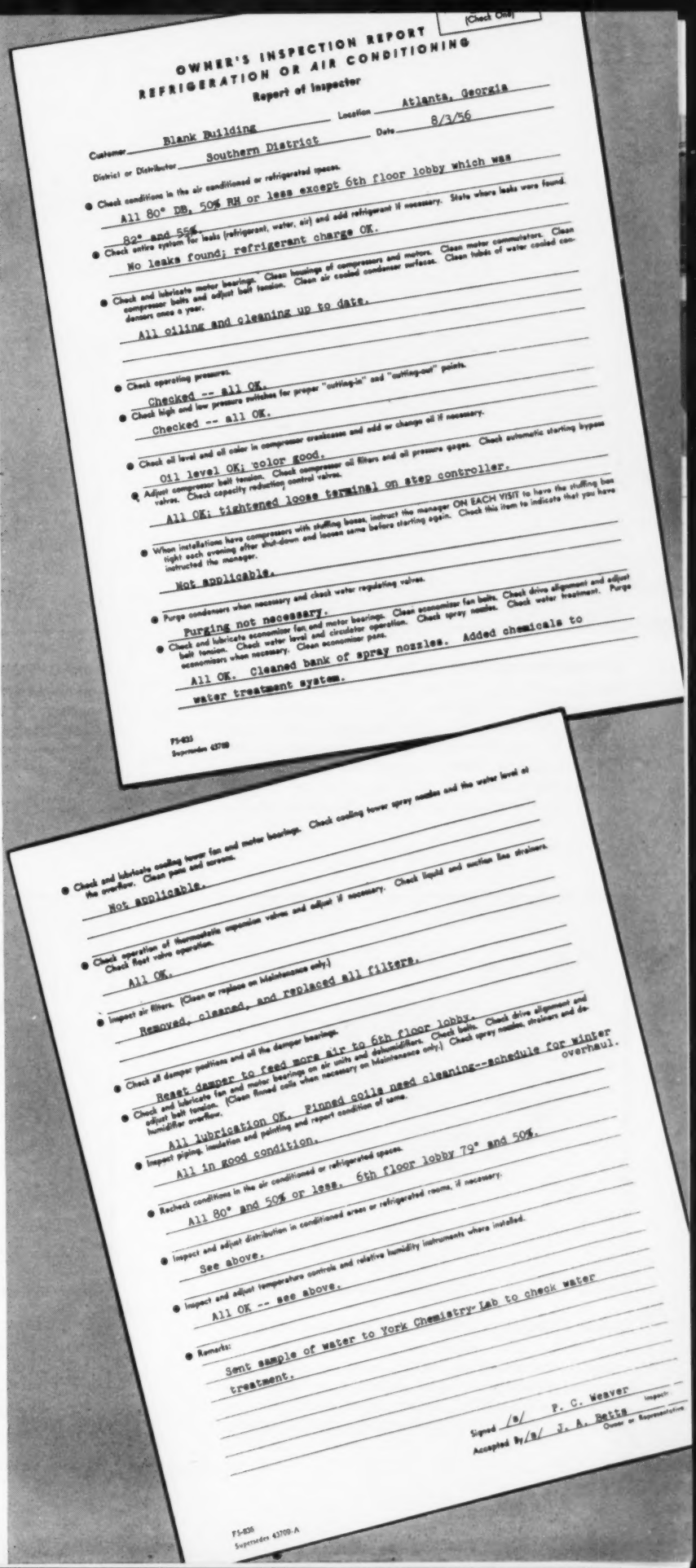
before its useful life runs out? Definitely not—because there is little likelihood of obsolesence. Most of the equipment is located away from the conditioned spaces. And what little remains in these areas can be concealed by interior decoration or by architectural treatment. Thus, appearance, which plays a key role in the obsolesence of consumer goods, has little effect on air-conditioning systems.

Obsolesence doesn't loom large engineering-wise either. The air-conditioning industry has made big strides in recent years. But if the original design of your system was carefully worked out, considering use, architecture and occupancy of the building, future developments aren't likely to make that selection invalid. And remember, the physical and chemical properties of air and water, key factors in any air-conditioning design, don't change.

In brief, the "immunity" of air-conditioning systems to obsolescence, coupled with useful building life of well over 50 years, makes it well worth your effort to stretch equipment life. No matter how you figure amortization, you'll pocket real savings. You'll be lowering actual depreciation rate while system usefulness — both mechanically and economically—is unchanged.

Significant trend as we see it: As specialization increases and as systems become more complex, more owners will be using maintenance contracts. These systems range from the smallest packaged units to the biggest central-plant installations. And the contract approach to preventive maintenance will continue to be most effective.

How many of these inspection operations would you overlook if you tried to do the job yourself?



OWNER'S INSPECTION REPORT
REFRIGERATION OR AIR CONDITIONING

(Check One)

Report of Inspector

Customer Blank Building Location Atlanta, Georgia

District or Distributor Southern District Date 8/3/56

- Check conditions in the air conditioned or refrigerated spaces.
  All 80° DB, 50% RH or less except 6th floor lobby which was 82° and 55%.
- Check entire system for leaks (refrigerant, water, air) and add refrigerant if necessary. State where leaks were found.
  No leaks found; refrigerant charge OK.
- Check and lubricate motor bearings. Clean housings of compressors and motors. Clean motor commutators. Clean compressor belts and adjust belt tension. Clean air cooled condenser surfaces. Clean tubes of water cooled condensers once a year.
  All oiling and cleaning up to date.
- Check operating pressures.
  Checked -- all OK.
- Check high and low pressure switches for proper "cutting-in" and "cutting-out" points.
  Checked -- all OK.
- Check oil level and oil color in compressor crankcases and add or change oil if necessary.
  Oil level OK; color good.
- Adjust compressor belt tension. Check compressor oil filters and oil pressure gages. Check automatic starting bypass valves. Check capacity reduction control valves.
  All OK; tightened loose terminal on step controller.
- When installations have compressors with stuffing boxes, instruct the manager ON EACH VISIT to have the stuffing box right each evening after shut-down and loosen same before starting again. Check this item to indicate that you have instructed the manager.
  Not applicable.
- Purge condensers when necessary and check water regulating valves.
  Purging not necessary.
- Check and lubricate economizer fan and motor bearings. Clean economizer fan baffs. Check drive alignment and adjust belt tension. Check water level and circulator operation. Check spray nozzles. Check water treatment. Purge economizers when necessary. Clean economizer pans.
  All OK. Cleaned bank of spray nozzles. Added chemicals to water treatment system.

F5-835
September 43708

- Check and lubricate cooling tower fan and motor bearings. Check cooling tower spray nozzles and the water level at the overflow. Clean pans and screens.
  Not applicable.
- Check operation of thermostatic expansion valves and adjust if necessary. Check liquid and suction line strainers. Check float valve operation.
  All OK.
- Inspect air filters. (Clean or replace on Maintenance only.)
  Removed, cleaned, and replaced all filters.
- Check all damper positions and all the damper bearings.
  Reset damper to feed more air to 6th floor lobby.
- Check and lubricate fan and motor bearings on air units and dehumidifiers. Check belts. Check drive alignment and adjust belt tension. (Clean finned coils when necessary on Maintenance only.) Check spray nozzles, strainers and dehumidifier overflow.
  All lubrication OK. Pinned coils need cleaning--schedule for winter overhaul.
- Inspect piping, insulation and painting and report condition of same.
  All in good condition.
- Recheck conditions in the air conditioned or refrigerated spaces.
  All 80° and 50% or less. 6th floor lobby 79° and 50%.
- Inspect and adjust distribution in conditioned areas or refrigerated rooms, if necessary.
  See above.
- Inspect and adjust temperature controls and relative humidity instruments where installed.
  All OK -- see above.
- Remarks:
  Sent sample of water to York Chemistry Lab to check water treatment.

Signed /s/ P. C. Weaver
Accepted By /s/ J. A. Betts Inspector
Owner or Representative

F5-835
Supersedes 43709-A

Service contracts prevent breakdowns like these . . .

A 37¢ screw in a suction valve on a 60-hp compressor of an air-conditioning system worked loose, fell into the cylinder. Since screws are not particularly noted for their compressibility (this one was no exception) something had to give. So $234 worth of parts "gave"—costing, in addition, four days of hot-weather operation.

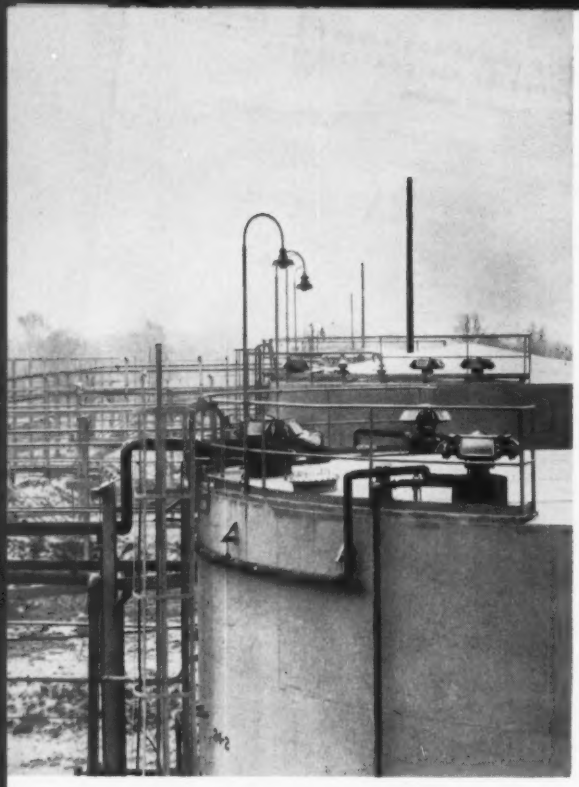
As one of the periodic inspections in a preventive maintenance program, an internal inspection of the compressor would have been made each year. Internal inspections are made during the winter season, when you're not likely to be operating refrigeration equipment.

Because of pressure of other duties, the maintenance man wasn't able to perform the internal inspection—if it was scheduled at all. Yet, the screw was loose for some time. And the condition could easily have been corrected by the most casual internal examination.

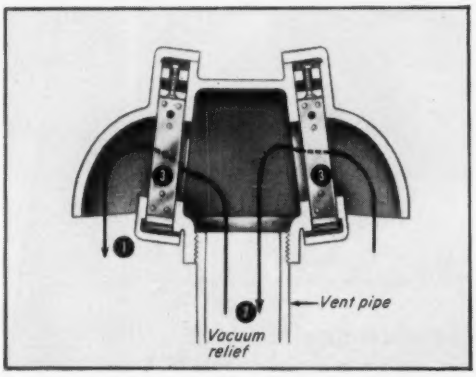
An odd breakdown? Yes. But its origin is common. And remember: most breakdowns begin with a seemingly insignificant item such as this one.

Fundamentals of

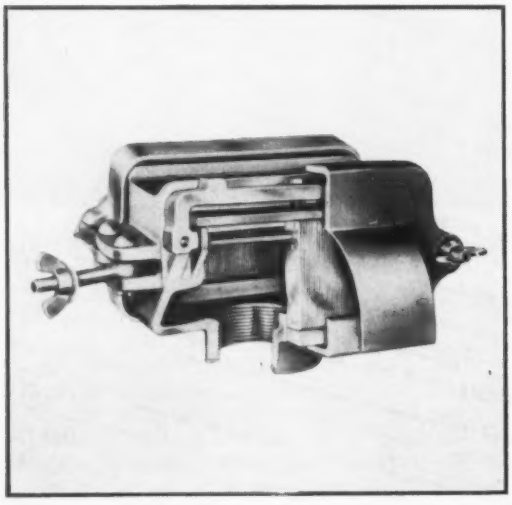
By R J ANDERSEN,



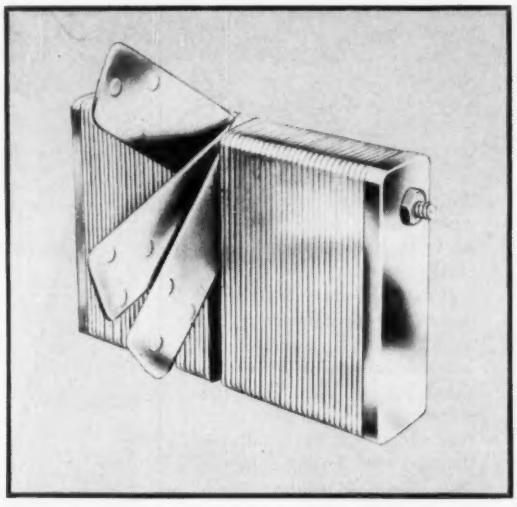
HAZARDOUS LIQUID STORAGE isn't a problem if your tank is well made. If it's above ground, tank must comply with local zoning regulations and those of National Fire Protection Assn. Despite location, tank venting is a must to allow air or vapor flow as tank fills or empties or contents expand and contract. Vents must be big enough and must be kept clear. Clogged or undersized vents can mean tank rupture or collapse.



NONCONSERVATION VENTS (used where vapor loss isn't important) allow pressure relief to or from atmosphere. Assembly should be a light-weight, easy-to-install housing to protect vent from air-borne dust, etc. Assembly should include removable, easy-to-clean flame arresters to guard tank contents against fire.



FLAME ARRESTERS should be easy to change or remove for cleaning. Type, above, has units mounted vertically outside vent housing. Vertical position allows free draining, prevents condensate freeze-up, reduces pocketing of liquid or dirt, is easy to maintain. Effective for its purpose, it does not hamper tank breathing.

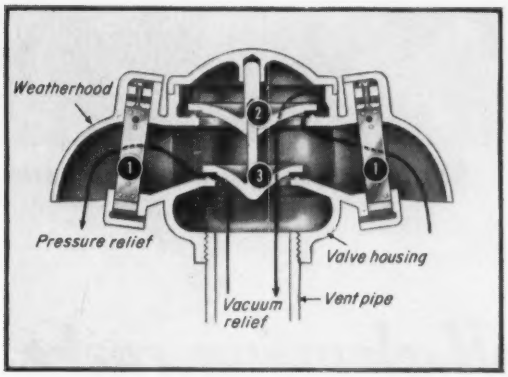


FLAME ARRESTER DESIGN can simplify maintenance. Vertically-mounted rectangular type, above, insures self-drainage. Embossed plate faces keep correct air space between plates. A desirable feature of this type is the single rod assembly that allows complete plate rotation to expose the surface for cleaning.

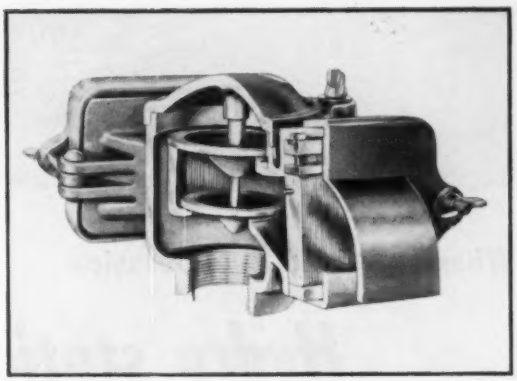
storage-tank venting

- Use vents that are big enough
- Use self-draining vent assembly
- Keep vents clean and clear
- Always use flame arresters

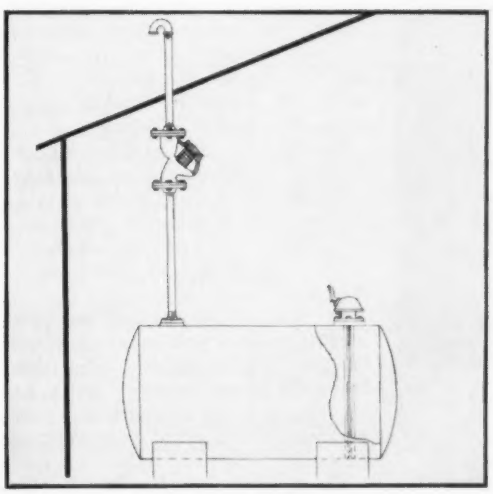
Technical Services Publications, The Protectoseal Co



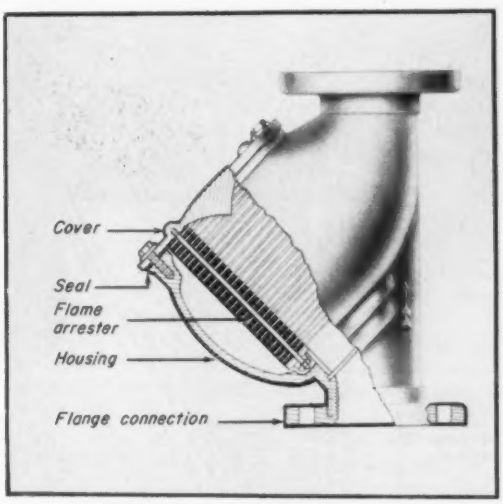
CONSERVATION VENTS (used where vapor loss would be hazardous to life or property) are similar in general design to nonconservation type. Difference is that valves are installed in housing. These serve to retard air intake or vapor escape as tank breathes normally, in and out, under normal working-pressure changes.



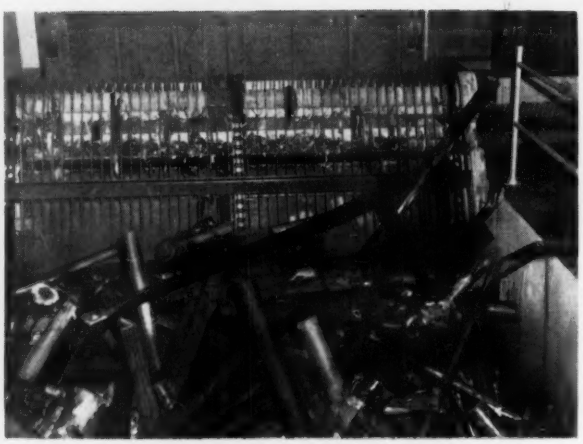
VALVES in conservation vents should be corrosion resistant and have right weight for accurate pressure setting and tight seating. Shape of pallets should provide maximum air-flow capacity. Valves should open and close only to relieve internal or external pressures that rise above normal working pressures.



OPEN VENTS from flammable liquid tanks, process vessels or waste gas lines should be equipped to prevent flashbacks. "In-line" flame arresters can be used at varying distances from open end of vent line depending on pipe diameter. Units can be installed in tank house with vent lines extended through walls or roof.



INSTALLATION inside the building simplifies inspection and maintenance. Arrester units should be interchangeable so one can be serviced while another is in the line. Type used should permit installation at an angle to make it self-draining. Indoor location has the additional merit of keeping the unit from freezing.

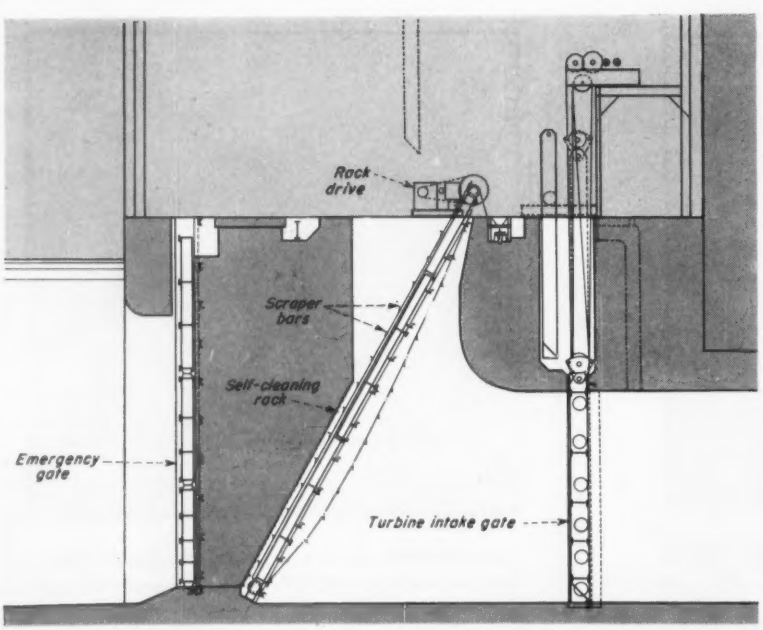


Rack rolls jumbled logs from intake . . .

When logs hold a jam session . . .

Hydro station self-cleaning racks

By L D McWILLIAMS
The Shawinigan Water and Power Co



CONSTRUCTION of self-cleaning rack resembles old-fashioned hay stacker, uses same simple operating principle. Endless chains carry bars moving at about 12 fpm

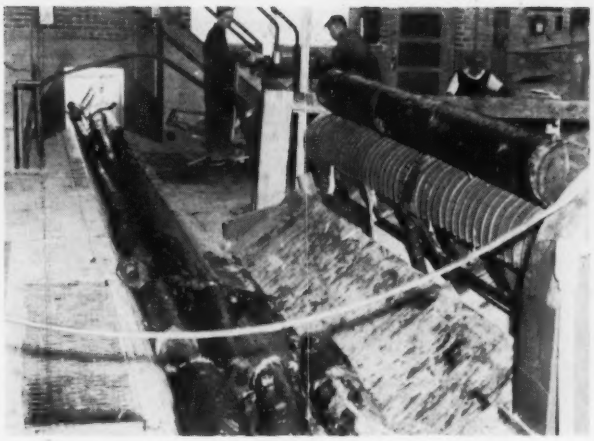
► DOWN THE TURBULENT St. Maurice river each summer travel some 50 million pulp logs on their way to paper mills. About 5% of the logs are "deadheads"water-logged and floating just beneath the surface, or bobbing downstream with one end barely showing.

Along this same river we have six power-generating stations. For years, during each spring and fall high-water period, our turbine intakes gathered odd assortments of debris: tree roots, branches, a dead cow, perhaps even a small boat or two. Ice breakup in the spring also gave us a bad time.

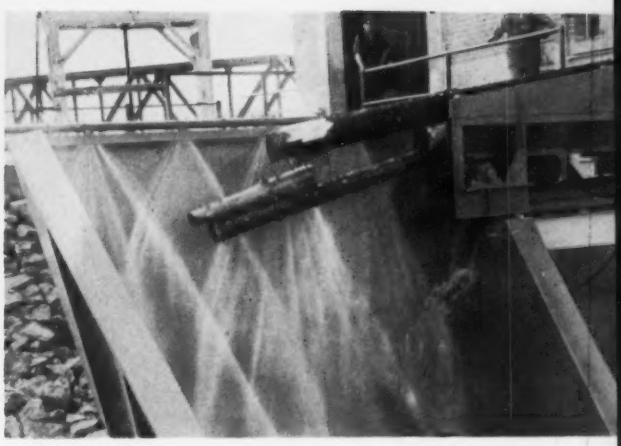
Deadheads, though, were our biggest problem. They'd pile up on the intake racks and cut off water to the turbines. Smaller ones would work their way through the rack bars—end up in the turbines. We'd have no choice but to shut down.

Our first self-cleaning rack was born because we knew we'd have to do something to lick the problem. The rack, brainchild of our engineers, had a lot of growing pains and took some reworking before it could do the job we wanted.

The cross section of rack, left, may remind you of an old-fashioned hayloader or stacker. Actually, our rack follows the same simple operating principle. We found that a slope of 60 deg gives best results. Moving parts are traveling link chains carrying transverse bars. As shown by the series of photos,



to inclined trough which sends them...



whizzing from log chute into tail race

tune up to clear intakes

above, rack bars pick up the water-soaked logs, carry them up out of the intake and dump them into a water-lubricated trough conveyor. This takes them to the log chute from which they're dumped into the station tail race. You might say that, since we couldn't fight off the logs, we kill 'em with kindness.

Welding was the tool that made design and fabrication problems easy for us. Some parts had to be machined, of course, and these we made in our machine shop. We bought the electric drive—speed reducer, sprockets, chains.

Rack frame consists of three rectangular sections (for easy handling due to lack of headroom) made from various sizes of I beams and channels. We cut the steel to desired length, laid the members in proper position on the floor and tacked them. With a section completely tack welded, we did the finish welding.

Completed rectangular sections had $\frac{3}{8}$ x $3\frac{1}{2}$-in. flat-iron rack bars edge-welded to the section framing. Spaced on $3\frac{3}{8}$-in. centers, these bars form the intake "screen." Next step was lowering rack sections into position in the intake pit, with lowest sections resting in checks in the side walls.

Driving mechanism assembly followed. Three link chains—one on each side, one in the middle of the rack—ride on depressed rails to keep tops of chains flush with top edges of rack bars. Special fittings on the chains, attached to brackets, carry the "scraper bars" which drag deadheads and other trash from the intake. Scraper bars are sections of $3\frac{1}{2}$ x 5-in. angle iron positioned across the edges of the rack bars. The assembly is powered by a $7\frac{1}{2}$-hp motor through a speed reducer (97:1 ratio) giving a chain speed of about 12 fpm.

Underwater idler shaft bearings were, at first, made of lignum vitae. Later, when this wood was hard to get, we shifted temporarily to a resinous-bonded material. However, our new racks have graphite-impregnated bronze bearings which, to date, have given good service.

Most important part of a self-cleaning rack is what we call the "flapper plate." Basically it's a valve that closes after each scraper bar passes around the lower idlers. A flapper valve has to be well designed if it's to prevent logs or trash from passing beneath the rack. If the flapper plate isn't right, a log can jam it in the open position. Then others pass beneath the rack and are soon thrashing around in the turbine scroll case.

Ice problems during winter and spring breakup periods presented a recurring menace to our operation. Too, we had to be on the lookout when conditions were ripe for formation of "frazzle ice." Frazzle (from the French *froid*—cold) ice isn't really ice nor slush, but something in-between. Forming in turbulent water—always at about $-\frac{1}{2}$ F—it can raise hob with hydro station intakes in a matter of seconds. Our engineers tackled these problems, produced electrically heated rack.

Heated racks are an integral part of some of our self-cleaning racks. Connected top section of rack bars forms a series-parallel immersion heater. On heated racks, a 1-in. strip of hardwood insulates scraper bars from rack bars.

During icing seasons we feed approximately 3000 amps at 100-150 v through the rack. This raises temperature enough to arrest ice formation around the rack. It also tends to melt jam ice on the surface and keeps large chunks of ice more or less on the move. When these come up against the racks they get the same heave-ho treatment given the logs.

The importance of keeping racks ice-free, and our success with heated racks, motivated the equipping of a recent installation with nine 450-kva transformers for rack heating only.

Hydro stations have their own peculiar "trash collection" problems, but at Shawinigan we're particularly vulnerable to log trouble. Our penstock intakes are rather high and certain topographical features are undesirable. However, our heated self-cleaning racks have proved that they can take it in helping to keep our turbines and generators on the job.

CORONA TEST SET includes controller and detector in case, plus h-v transformer

Have you thought about corona testing for electrical maintenance?

Corona tests are being adopted by electrical manufacturers and are now getting attention for preventive maintenance

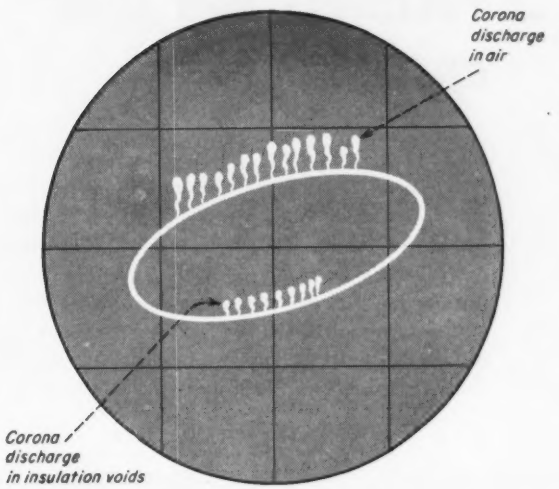
► CORONA TESTING is a brand new idea as far as plant maintenance is concerned, so new that there is very little field experience to report. But equipment manufacturers' experience in recent years suggests that corona tests may have a place protecting reliability of installed electrical apparatus. New installations could be checked for susceptibility to corona discharge and unsatisfactory conditions corrected before equipment is put into service. Old installations could be checked periodically to determine if insulation has deteriorated to point where it might break down. Tests could be used on high-voltage cables, transformers, bushings, circuit-breakers, even motors.

Corona tests are not simple and equipment is expensive compared with more familiar insulation testing apparatus. It's heavy and for some test conditions can require large amounts of power. What's more, experience is necessary to interpret results. Corona test procedures now in use by manufacturers are far from perfected. Considerable research is being done to improve equipment and techniques. In spite of these disadvantages, however, corona testing deserves consideration in plants where dependability of electrical equipment is extremely important.

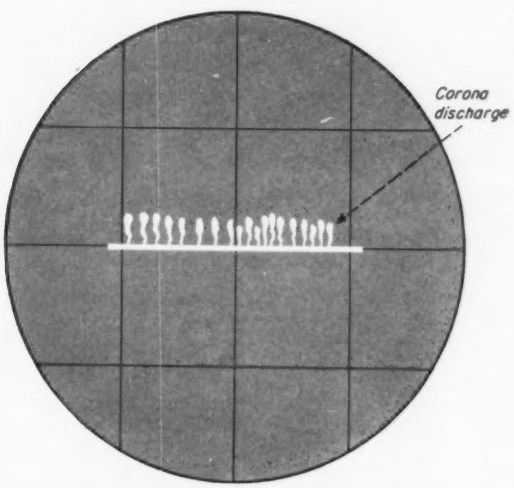
Corona is a phenomenon that occurs under certain conditions when a voltage is applied across insulation. The electric field established by the voltage causes electrons in limited areas of the insulation to reach a high energy level. A space charge is produced around the area. There is no disruptive discharge, or breakdown, through the insulation. However, energy is given off in the form of electromagnetic waves. Corona of sufficient magnitude in air is visible. Low-energy corona can be detected by corona-test detectors. Corona may occur in air at the surface of the insulator or in tiny bubbles in a liquid or voids in a solid. (In some types of equipment it is possible to distinguish between corona in air and corona in the material by means of the corona tester.) Occurrence of corona depends on the voltage and on the kind, shape and condition of the insulation.

With a corona-test set you apply a carefully controlled voltage to the insulation, increasing it until corona is detected. The susceptibility of the equipment to corona, the voltage at which it occurs, and other corona characteristics, are thus determined. Commercially available corona-test equipment consists of a control unit, high-voltage transformer and detector. The control unit is supplied with power at regular voltages—120, 230 depending on the model. Unit includes an auto-transformer or induction regulator by which you vary primary voltage of corona-free h-v transformer. Output voltage of h-v transformer is applied to equipment under test. Test voltage is adjustable from zero to 20 or 30 kv in standard test sets and to 80 kv or higher in specially designed sets. The detector picks up electromagnetic waves generated by corona discharge and displays them on cathode-ray oscilloscope

Corona pulse patterns



PULSE PATTERNS enable you to interpret corona characteristics. Distinct positive pulses indicate corona discharge in air. Pulses on negative side come from internal corona



MAXIMUM PULSE HEIGHT must be measured to determine corona intensity. Calibrate scope to measure pulse voltage. Multiply pulse height by sensitivity factor and capacitance

built into set. A vacuum-tube voltmeter in the detector indicates test voltage at which corona occurs. Detector is designed to exclude waves not originating from the corona.

Corona can rapidly deteriorate insulation and cause breakdown, depending on corona intensity and nature of material. Corona produces ozone, nitrous and nitric oxide in presence of air, and at high levels, heat. Time required for corona to cause failure depends largely on intensity of discharges. Some equipment can "live with" low intensity corona for years.

When making a corona test you will measure one or more of these quantities: corona starting and extinction voltage, corona intensity and energy, and relative corona intensity versus applied voltage. In many cases, the corona starting and extinction voltages will be sufficient, but in other cases, to get a useful knowledge of corona conditions, elaborate tests will have to be made. Tests on transformer, capacitor and switchgear bushings, for example, are fairly simple and give conclusive results. Tests on cable, while not difficult to interpret, can require large amounts of power because of the large capacitances involved. Tests on motor and generator windings are difficult to interpret, and engineers who have done extensive research on the subject believe it is too early to recommend corona tests for motors. Such a test, when it is better understood, will be valuable for safeguarding reliability.

Corona starting voltage is determined by increasing applied voltage until pulses are noted on the oscilloscope. Voltage is held constant for 15 to 60 seconds, and if corona is not sustained, voltage is increased until it is sustained. Voltage at this point is corona starting voltage. By slightly increasing the voltage, and then decreasing it slowly until pulses disappear, the corona extinction voltage is found.

Apparent corona intensity is a measure of the largest individual charge lost by the insulation during corona discharge. The intensity is obtained by multiplying height of maximum pulse obtained on the oscilloscope by the product of the capacitance of the insulation under test times the sensitivity factor of the detector (volts per unit deflection on the oscilloscope).

Apparent corona energy equals 0.707 times the apparent corona intensity times the applied voltage read on the detector meter. (If intensity is in coulombs, energy will be in watt-seconds.)

Relative corona intensity is measured by connecting an auxiliary voltmeter to the output of the detector's amplifier. The meter reading is proportional to the apparent corona intensity and the number of pulses per cycle of applied voltage. Values so found are generally given as a curve plotted against applied voltage. This curve resembles a power factor-voltage curve, and is interpreted in a similar manner.

Corona testing, as can be seen from this brief summary, is not a cut-and-dried procedure. A great deal more has to be learned about it before anyone can speak authoritatively on the subject. Its usefulness as a maintenance method will increase as techniques and interpretation of tests are improved.

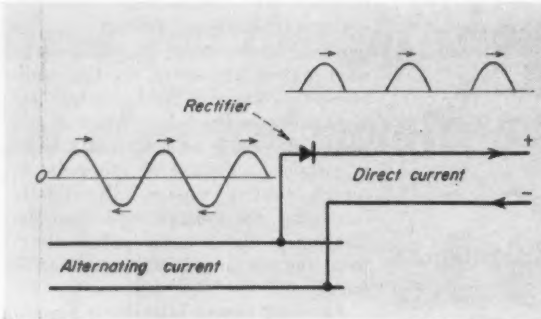
Plant Electrical Fact File

NO. 14: RECTIFIERS

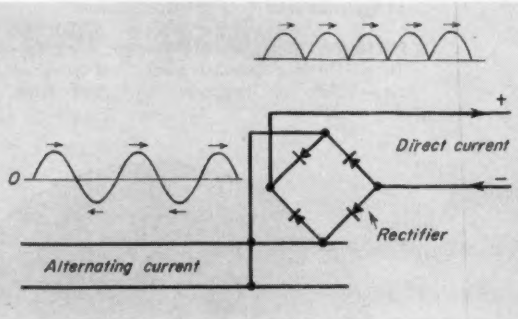
5 rectifiers and their applications

► Rectifiers of all sizes and various types are finding applications in industrial plants. They're pushing rotating machinery out of the picture except where close voltage control must be combined with large amounts of power. Some features of five leading types of rectifier are discussed in these pages. Chart at right shows where larger units fit into the power picture in regard to current and voltage. Other types are sometimes designed for special applications.

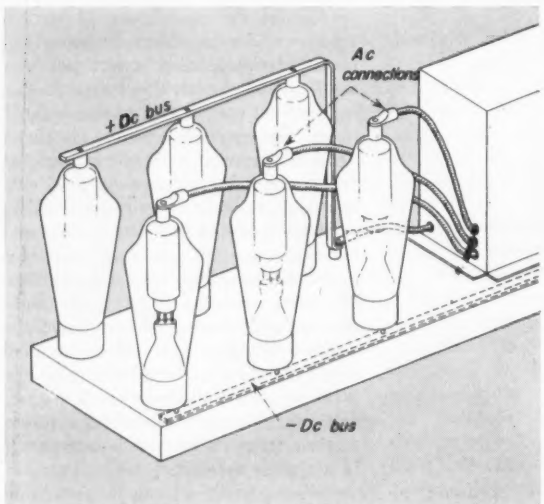
By NORMAN PEACH, *Assistant Editor*



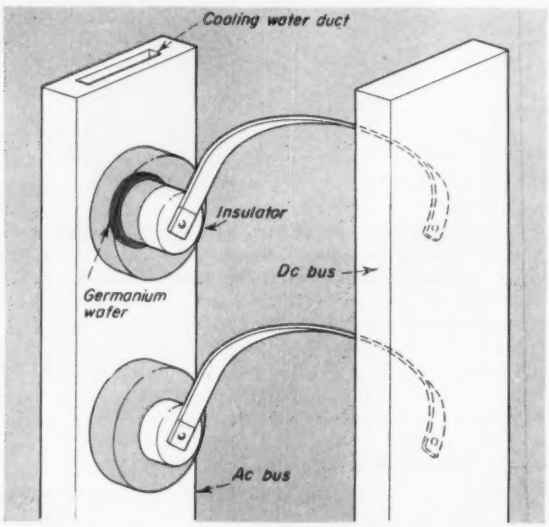
RECTIFIER ELEMENT works like an electrical check valve; it lets current flow in one direction but not in the other. Half-wave rectifiers pass current during only half of ac cycle, delivers only half power. Advantage is simplicity of circuit.



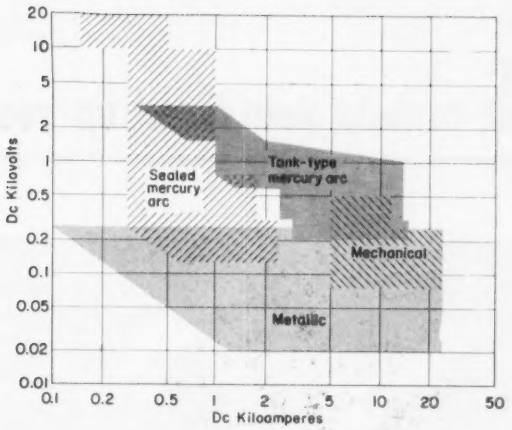
BRIDGE RECTIFIER gives full-wave current, full power, but direct current is still pulsating from zero to maximum. Two rectifier elements and transformer with center tap can be arranged to give full-wave dc same as the bridge rectifier circuit.



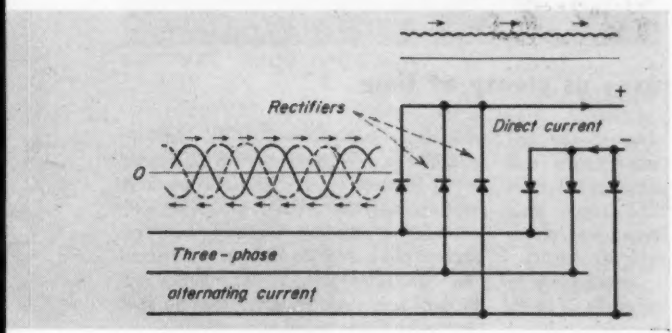
1 **ELECTRON-TUBE** or hot-cathode rectifiers can deliver up to 40 amperes per tube. They have same application as simple rectifiers, but are used most advantageously in connection with control circuits, especially in armature and field control of dc-motor speed. Tubes are fairly rugged, air-cooled, and can be easily replaced when they break down.



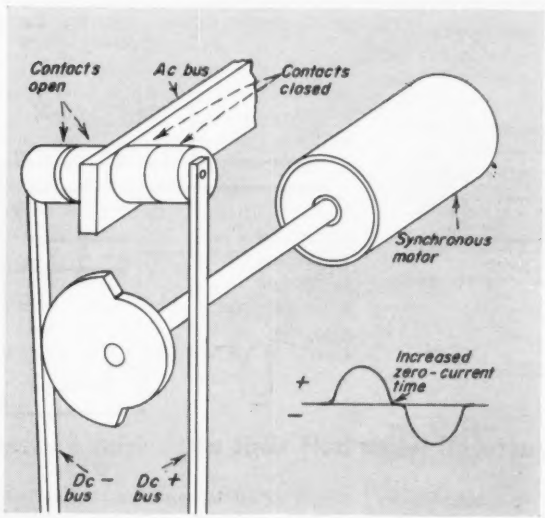
2 **METALLIC** or semiconductor rectifiers are growing in capacity and variety of use. Air-cooled selenium and copper-oxide types are familiar for low-power jobs. Germanium, and now silicon, cells are moving into high-current area formerly dominated by mercury arcs. Units are smaller, maintenance and repair easier. Water or air cools cells.



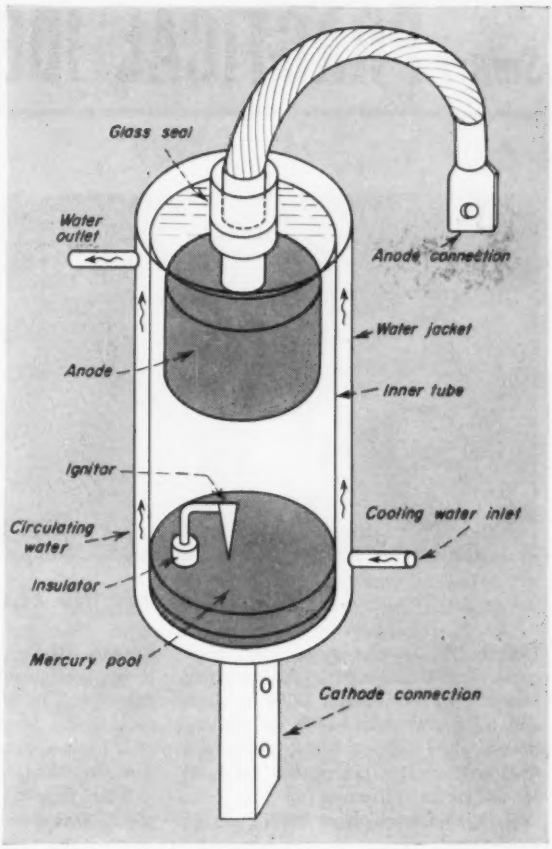
CURRENT AND VOLTAGE ratings of large power rectifiers



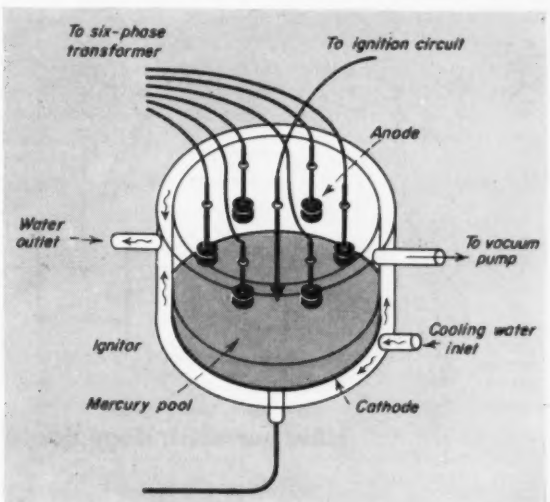
POLYPHASE RECTIFIER produces dc with only a small ripple; even half-wave dc doesn't fall to zero. Full-wave gives voltage boost by addition of waves. Ripple is further reduced by transformer converting three-phase ac to six or more phases



3 **MECHANICAL** rectifiers have performed well in high-current installations, but haven't gained wide acceptance. Simplified sketch shows one pair of contacts. A similar pair operates with other ac bus. Full-wave dc is obtained. Reactors in ac supply extend zero time so contacts aren't carrying current when the circuit is opened and closed every cycle.



4 **SEALED MERCURY-ARC** or ignitron rectifiers handle large share of conversion applications; are best for high voltages. Maintenance is simpler than with tank types. Ignition circuit starts arc which rapidly builds up to full amp.



5 **MULTIANODE** or tank-type mercury arcs are the heavyweights among rectifiers. They require skillful maintenance, but give good performance for large-power installations. Anodes conduct in sequence; ignition circuit starts arc, excitation circuit keeps it going. Vacuum is usually maintained by external pump. The tanks are water-cooled.

Smart PRACTICAL IDEAS *to help you speed up your*

Drill jig makes life easy, saves us plenty of time

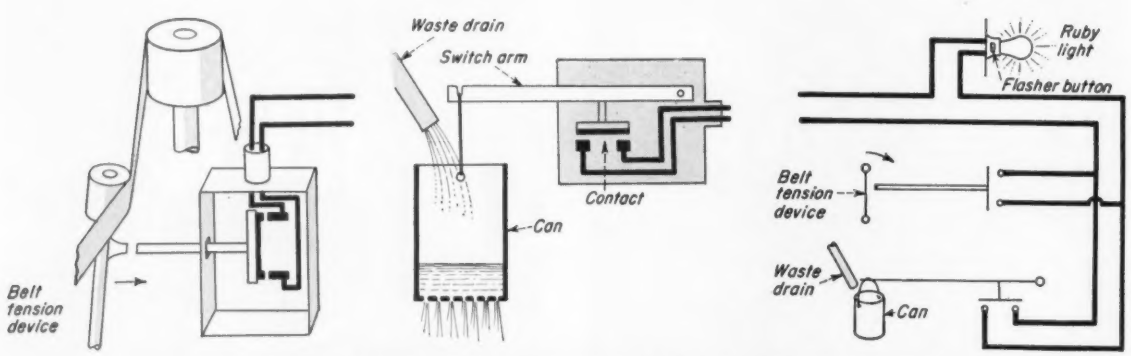
Installing rails on our overhead track conveyors is easier with jig shown in photo. We save about 80% in time and labor. We also use it for drilling heavy metal plates, I-beams, channel irons and similar pieces that are hard to get to a drill press.

Rail job for which we use jig means fitting and bolting ⅜ x 2½-in. steel rails onto previously placed cast-steel hangers. Before, we clamped the rail to hangers, marked the holes on rail corresponding to hangers, moved rails to a drill press, drilled holes, took rails back to job and bolted into place. We often had to ream holes to fit.

With jig, the holes are drilled in place. One man now bores the 7/16-in. holes, installs the ⅜-in. carriage bolts.

You can make a similar jig for either electric- or air-powered drills. Ours is adapted to a ½-in. electric drill. Frame is ¾-in. steel rod, bent at one end to fit snugly over rail. Opposite end contains a standard C-clamp, with attached piece bent to fit over drill handle. Shoulder support for chuck end of drill is a shaft collar, turned to size and welded into position.

H N JOSLEYN, *Fort Dodge, Iowa*



Now our centrifuge doesn't waste oil when belt slips off

Each time our lube-oil centrifuge lost its water seal or jumped its belt, lube oil poured out the waste drain and was lost. At 10 gpm loss, something had to be done about the situation.

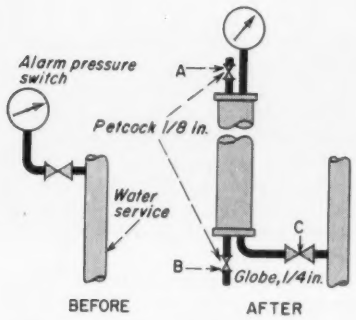
We used two normally-open switches; placed one so that the belt tension device closed it if belt came off, first sketch. Other switch was mounted so its arm was under the waste drain. We then hung a can on switch arm, second sketch. Can has holes punched in bottom. Normal amount of water out of waste drain leaks out through these holes. But a gusher of oil quickly fills the can. Then, the additional weight of oil in can closes the switch.

Closing of either switch turns on a light on the operating flat, third sketch. As an added attention getter, we use a ruby bulb with a flasher button behind it. With a minimum of expense, we now get maximum results.

J W SHAFFER, *Seattle, Wash.*

operation and maintenance jobs

STEVE ELONKA, *Associate Editor*



New hookup gives correct gage readings

Our powerhouse water-service supplies the drainage sump eductor pump, cooling water, other equipment. Water is from a high-pressure line through pressure-reducing valves. Because of the widely varying flows in the system, two pressure reducing valves (PRV)—¾ in. and 2½ in. were installed in parallel.

Normally the ¾-in. PRV was in service, but when the float-operated eductor pump opened, pressure fell to zero for a few seconds until the large PRV opened. So the operator got a false water failure alarm at each pump operation. Sketch, above, shows how we solved problem.

To set up; close globe valve *C*, open petcocks *A* and *B* to drain water from the reservoir pipe. This reservoir is 2-in. pipe, 30 in. long, capped at either end, sketch. To operate, close *A* and *B* slightly, open *C*. Water pressure failure affects the alarm until a preset time delay that's needed to bleed the water from reservoir. In our case, valve *C* was adjusted to give somewhat greater time delay than normally needed for the large PRV to restore pressure upon eductor pump operation.

K H HUNICH, *Rockport, Wash.*

Here's how . . .

to remove a bearing outer race, or cup from a recess where there's no way to drive it out from the rear. Run a bead around the inside surface of the race with an electric welder. When it cools, contraction of the weld will loosen the race so you can easily remove bearing.

M JOHNSON, *Winona, Minn.*

What would you have done?

I was chief on a new laker that was still in the building yard. Main condensate pumps were in a pit about 2-ft deep, below engine-room tank tops. That was to give pump a suction head from bottom of main hotwell only 6 ft above tank tops. Pumps were 3450-rpm centrifugal verticals, two-stages, motor driven.

One pump passed test, discharging water at 100 psi against deadend. Other pump discharged a mere trickle. With discharge closed, it built up only 50 psi. Yard mechanics checked (1) suction line for obstruction (2) discharge line (3) vent from suction to condenser (4) impellers for fouling (5) passages between two stages (6) rotor and wearing ring clearances (7) packing and gland sealing lines (8) check valves for flow direction and operation (9) rotation of pump. Rotation was double-checked by three yard mechanics and by the yard super. But still the pump didn't improve.

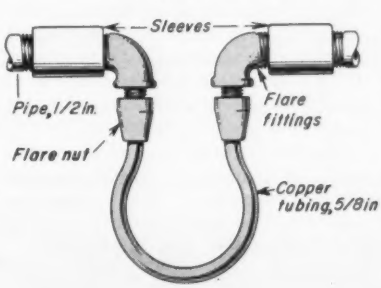
After a week of checking, the yard super concluded that impellers were wrong design. He gave orders to rip them out and ship them back to the manufacturer on Monday.

That Sunday no one was around so I checked the pump's blueprints. Only thing I could think of was rotation, but everyone had checked that. Besides, I don't think she'd build up 50 psi with wrong rotation. Rotation was hard to observe because of pit's location. I hit the start, then the stop button, then dropped quickly into pump pit before shaft stopped turning. Rotation *was* in wrong direction. I hopped out and checked twice more.

Monday morning I met the foreman on deck as his crew started below to dismantle the pump. He bet me $10.00 I was wrong, then told his electrician to change the motor leads, "just for fun." With leads changed pump did everything she was supposed to do. Like Marmaduke, I took his dough. What would *you* have done?

E R KAARLELA, *Highland, Ind.*

Expansion joint stopped joint trouble

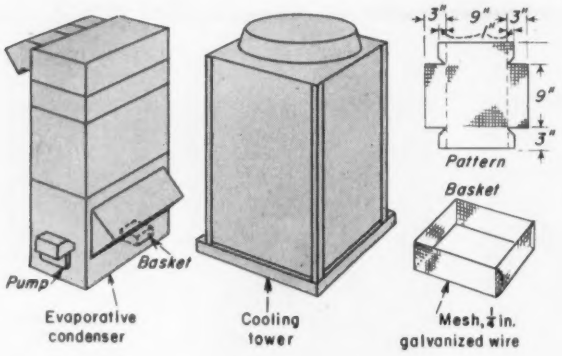


Our steam tracer lines were always failing at joints. Then we'd have to remove the insulation and search for the leaks on our outdoor tracer lines. Checking the 300-foot length of piping, I found no provision for linear expansion. So I made expansion joint from copper tubing, sketch. We've had no more trouble from joint failure.

T MULLIN, *Seattle, Wash.*

Turn page for more Practical Ideas ▶

Begins on page 136



'Shotgun method' stopped corrosion, scale troubles

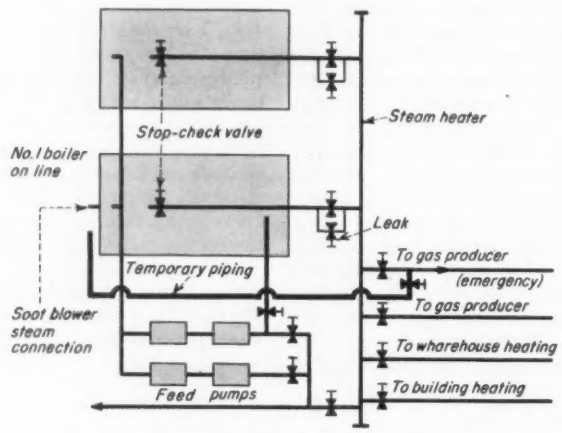
A large firm, with many air-conditioned plants in various parts of the country, had trouble with corrosion and mild scale in cooling towers and evaporative condensers. Small metal towers were knocked out of service for good. *Cause:* badly corroded steel sheets.

Plant capacities were from 10 to 300 tons. Some plants used raw soft water; others had zeolite softeners, but corrosion was still a problem. While correct water treatment could have stopped trouble, unskilled operating help in the plants didn't get results. So I based solution on a foolproof method. Here's what I did:

I made a chart for all plants, giving a treatment schedule for each installation. Correct number of briquettes to be used during each operating period were shown. Instead of using complicated feeding equipment on these jobs, copies of sketch, above, were mailed with each chart. This showed operators how to make a wire basket and where to locate it in their equipment for best results.

All water-treatment orders from these scattered plants are now cleared through the main purchasing office. This allows one person to keep a close check on usage. While this method of treatment is admittedly a 'shotgun method,' it has successfully curbed corrosion failures and scale troubles.

E F WEHLAGE, *Fairport, N. Y.*



Here's your trick of the month

By-pass line on a header valve developed a leak. Our plant manufactures window glass, operates continuously 24 hours per day, 7 days a week for periods of 3 to 4 years. Steam was for producer gas and building heating, sketch. We knew we had to repair the leak, but how? Several alternates were considered: (1) Shut down producer gas operation and use natural gas for glass furnace. This couldn't be done until summer, would need many manhours to change fuels and would possibly upset glass production. (2) Rent a portable boiler or locomotive and connect it to gas producers. Gas producers need 4000 lb steam per hr at 135 psig. This would be expensive and require a lot of temporary piping. (3) Isolate header and supply steam to gas producers from a connection not common to header.

The third scheme seemed impossible until we thought of the 2½-in. soot blower connection. This connection was direct to steam drum and large enough to supply 4000 lb per hr.

We used steam from ¾-in. vent connection on boiler to run boiler-feedwater pump. Boiler was on line and air vent not needed. Then we connected standby boiler-feedwater pump to air vent, and soot blower to an existing emergency steam line to gas producers. This connection was made immediately before repairing the leak.

With all preparations made, personnel in boiler room, gas producer department and maintenance were fully instructed. Gas producers were supplied by steam through soot blower connection and all heating lines were shut off. When we saw that producers could operate OK from this source, we closed stop-check valve on boiler. Pressure was bled to atmosphere. The leak repair took only 30 minutes. When completed, the stop-check valve was opened and steam again supplied through the header.

Next step was to prevent problem from coming up again. One solution was a looped header design, but cost was too much. Also, isolating valves might fail to seat. We found by-pass valve had been left open, wire drawing its seat. We now check this valve carefully. And all portions of header and header piping are given a more thorough examination during the infrequent shutdowns.

H FRYE, *Vincennes, Ind.*

Turn page for more Practical Ideas ▶

ALLIS-CHALMERS

Water Conditioning

ON THE JOB

Happy Solutions To 4 Typical Water Problems

● Everybody seems to have problems when they use water. It's too pure, or it isn't pure enough . . . or it needs conditioning for the job it has to do. In any case, a specialist is needed. Here are typical examples of Allis-Chalmers water conditioning service, equipment and chemicals at work solving varied water problems.

Drought Adds to Woes of River Water Users

CALIFORNIA—Things looked bad at a paper company when the first water samples came in. In fact, one water conditioning company went so far as to say that the alkalinity of the water could never be reduced to a satisfactory level.

But on the assurance of Allis-Chalmers experts, a de-alkalizer was ordered for boiler make-up water.

In the meantime there was a drought. The drought made the river water conditions even worse than they had been, so that by the time the equipment was installed there was real trouble with alkali.

Allis-Chalmers engineers had an unusually tough problem on their hands. Instruction, experiment, on-the-spot service, and a program of constant control have resulted in production of satisfactory boiler make-up.

Saved $60,000 in New Equipment

LOUISIANA—A low pressure industrial steam plant was being supplemented by a 1250-lb boiler. The question arose—can any of the old water conditioning system be used? Preliminary investigation indicated the need for demineralization equipment to get the desired water quality for make-up in the new equipment.

A survey of the records showed that it would be possible to use condensate from the low pressure system as make-up for the high pressure system. This solution of the problem required less modification of equipment than was originally anticipated . . . saved an estimated $60,000.

Stained Glass Has Its Place, But Not in Nursery

ILLINOIS—A nursery was spraying water over the outside of its glass hothouses to control the temperature inside. The method was effective, but the iron stains from the water were troublesome. Allis-Chalmers water conditioning experts recommended A-C's 130 Series complexing agents. This did the job by preventing the iron from depositing on the glass.

Battle with Algae Ends in Knockout

KENTUCKY—A petroleum company is finding out what a lethal weapon Allis-Chalmers new 120 Series algaecide really is. Previously they used sodium hypochlorite, but their cooling tower algae problems were not solved. Now they have complete control . . . using concentrations of only one-half of what is normally recommended. They also say it's easier to handle and apply, and better in every way, than anything they've ever used before.

Get Help on Your Water Problems

Whether you need chemicals, equipment or service, Allis-Chalmers provides an unbiased recommendation based on over 25 years' experience. No problem is too big or too small. Specialists are located in many cities. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

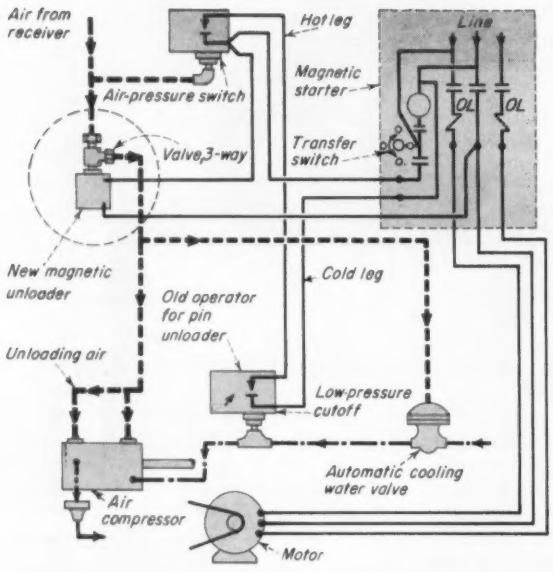
ALLIS-CHALMERS

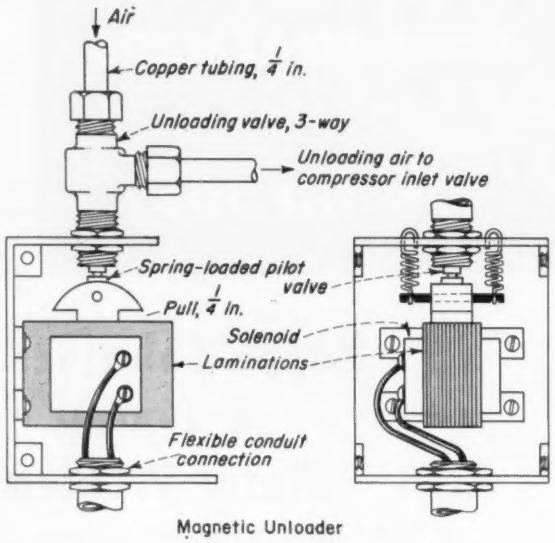
A-C ALLIS CHALMERS

A-5304

More PRACTICAL IDEAS

Begins on page 136





Magnetic Unloader

This magnetic unloader does top job for our air compressors

Many operators are faced with failure of 3-way unloading valves to seat properly when unloading compressors and intake valves. *Result:* constant leaks.

Our trouble was not in the 3-way valve itself, but in manner it operated. Usually, valve is operated by a small pin projecting from side of pressure control switch housing. Pin is attached to the differential arm of switch. It takes about 3/32-in. movement to operate unloading valve. This makes a critical setting as valve itself requires about the same movement to load and unload. Any disturbance of connecting tubing, or a little extra vibration, knocks it out of kilter. And, to make matters worse, we operate our pressure switch on lowest differential possible. Lowering the differential pressure gives us less tension on differential bar of switch and leaves barely enough tension to close the 3-way valve.

I made a magnetic unloader, first sketch, by removing the 3-way valve from switch housing and operating it with a small solenoid. Solenoid has a 2-lb pull at ⅛-in. stroke.

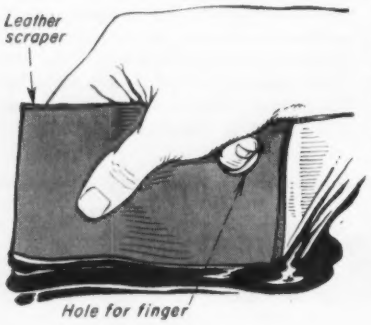
One solenoid terminal is connected directly to middle-leg motor terminal of the magnetic starter (you might connect directly in terminal box on motor itself to simplify wiring). Other terminal of solenoid goes to the 'cold' terminal of pressure switch. In this way the unloader operates the intake valves on either 'hand' or 'auto' position of the starter transfer switch. 'Auto' position starts and stops the motor according to demands of pressure switch. In the 'hand' position the motor runs continuously and demands for air are satisfied by the 3-way valve, raising or lowering the compressor intake valves. This was previously done by action of pressure switch raising or lowering the differential arm to operate the 3-way valve.

Since the pressure switch is still in the circuit, I take advantage of its contacts opening and closing, whether it's on 'hand' or 'auto' circuit, to operate my valve.

Second sketch, above, shows standard air-compressor circuits with usual controls and new magnetic unloader.

R BOETINGER, *Englewood, N. J.*

Leather squeegee wipes up oil efficiently



I use a piece of 3 x 5 x ¼-in. leather belt to wipe oil from pans. Hole, sketch, fits user's little finger, leaves both hands free to handle pans. You can scrape cylinder oil slick as a whistle and leave your pan or tray clean and practically dry. It used to take about 45 min to wipe the pans around our 1903 Fitchburg engine. And we'd have to use a pail of waste. Now I do the job in 5 to 6 minutes at most.

A R HALEY, *Templeton, Mass.*

Do you know . . .

how to lay up your boiler wet? How to lay it up dry? *Plant Operators' Manual* shows you with detailed sketches.

My biggest boner

Please turn to page 224

boiler water levels now easier to **see**... easier to **read**

Whatever the boiler pressure, high or low, YARWAY Remote Indicators give accurate, instant, eye level boiler water level readings at any convenient plant location.

Boiler Code Case No. 1155* says in part, "... two independent remote level indicators of the compensated manometric type may be used instead of one of two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 900 psi..."

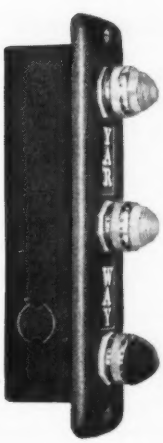
YARWAY Remote Liquid Level Indicators fill the bill—and feature a "wide vision" face that makes reading easier from any angle.

Accurate—because indicator is actuated by the boiler water itself—by the pressure differential between a constant head and the varying head of water in the boiler drum.

Also use YARWAY Remote Indicators on heaters of various types.

For full description, write for YARWAY Bulletin WG-1824.

*Write for free reprint of case description.

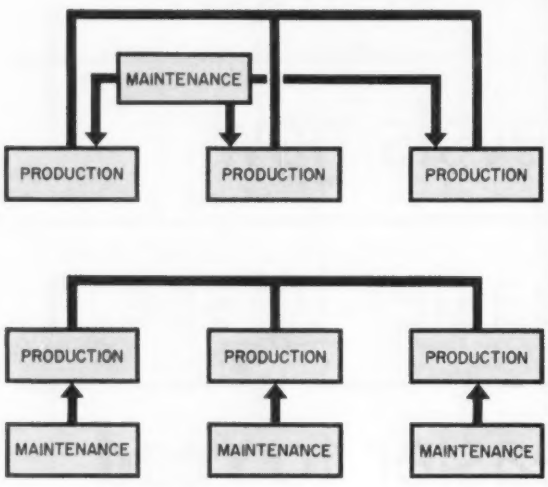


Yarway Remote Hi-Lo Alarm Signals—lights or horns—can be used with Yarway Remote Liquid Level Indicator and placed at any location in the plant.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Penna.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® REMOTE LIQUID LEVEL INDICATORS

Have a PLANT PROBLEM? *Tap the*



The problem

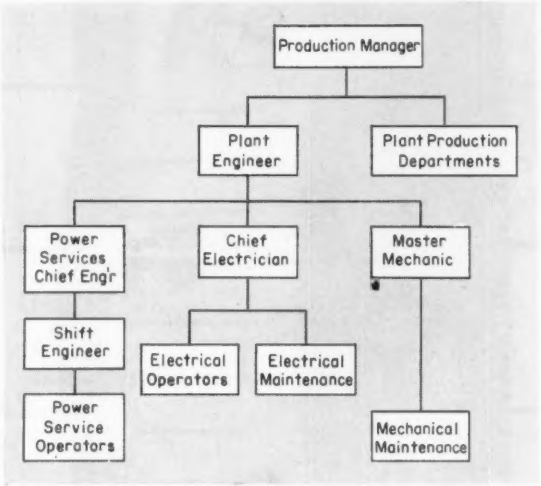
Should we use centralized or decentralized maintenance?

I've just taken over the job of plant engineer for a new plant that consists of two one-floor manufacturing buildings spreading over about 500,000 sq ft. The plant manufactures and assembles intricate electrochemical equipment. We supply our own steam and softened water. And we have control of our electrical power from our own substation.

Production-wise, each department is responsible for its own operation. In contrast, the utilities are common to the entire plant and it would be difficult —and undesirable—to divide responsibility for maintenance of these items. Yet, many of the skills required for utilities maintenance are also common to production-equipment maintenance.

Should we have decentralized maintenance specialists for each production area and allow operating departments to keep their own maintenance records, programs, etc? Or, should we have a completely centralized maintenance program for the entire plant? Is there a compromise?—*EEC, February Power*

The solutions



EEC should try this setup

The above sketch is the *family tree* of a plant that is similar to *EEC's*. It should do the job for him.

With the power-services engineer, chief electrician and master mechanic on the same general level of authority, division of responsibility comes naturally.

A word of caution: the operating-shift electrician should, on night shifts, be responsible to and report to the engineer in charge of the power services shift. Otherwise, *EEC* will find himself with a loose end in his setup.

H P Taylor, *Bellevue, Neb.*

Use centralized maintenance

This is a relatively large plant. So each department head has considerable responsibility. His first and most important duty is to maintain a high standard of production, both in quality and quantity. To do the best possible job, department heads, and employees under them, should have no duties to perform other than those involved in production.

If each department head has to take over the maintenance of his equipment, he'll be diverting time and energy from his production duties. And there will be uniformity among maintenance systems in the different departments.

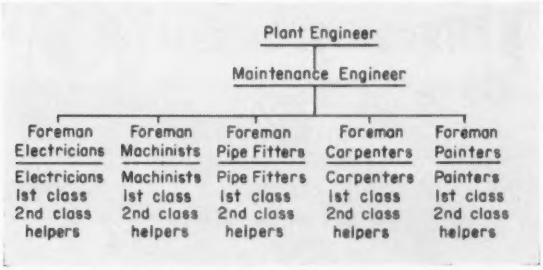
Thus, in a plant this size, there should be a centralized inspection and maintenance program for the entire plant, with one official in charge and responsible for its upkeep.

H T Livingston, *Los Angeles, Calif.*

Want help with your plant problems? Send your design and operating headaches to us. We'll give *Power* readers a whack at them.

know-how of over 45,000 Power readers

HOWARD KALLEN, *Associate Editor*



Eliminate duplicate effort

Usually, a centralized maintenance group provides maximum service at minimum cost. With this arrangement, duplication of certain crafts and skills may be eliminated, thus limiting manpower requirements.

Electricians are a typical example. With this skill available from a central group for all areas, the men are free for power and lighting maintenance at all times. With good scheduling this setup keeps the staff working at a nearly uniform rate, avoiding slack and rush periods. Also, the men get greater experience by performing a variety of jobs.

By establishing a preventive maintenance schedule for the various services, equipment and facilities are kept in top condition, minimizing risk of interrupted production.

The sketch above is a simple arrangement of manpower.

H B WAYNE, *Woodhaven, N. Y.*

Central control is needed

I would suggest that *EEC* set up a centrally controlled maintenance group with an area supervisor or foreman in charge of each sub-group in a specific production area. Area mechanics can be assigned to particular production areas to handle routine maintenance problems. Maintenance time-cards, equipment records, machinery history can be kept in the central maintenance or engineering office.

Large or major maintenance requirements such as major equipment repairs, installations, removals, building additions, alterations, would be scheduled and controlled from the central office regardless which production department is involved.

In this way, the plant engineer has an accurate picture of the whole program and still has flexibility for rapid service to various production departments.

T H MCCARTHY, *Redwood City, Calif.*

Main thing is good leadership

The kind of maintenance program *EEC* should choose depends on the number of employees, machines, number of shifts and whether the maintenance is general or specialized.

Any plan, if carried out by qualified men under good supervision, will be beneficial. In contrast, the best plan can fail if efficient leadership is lacking.

C BACHMANN, *Jamaica, N. Y.*

Small plant should use centralized, large plant, decentralized

A small plant can get by on centralized maintenance. Large plants need a decentralized maintenance system, or a modification of it. Here is a setup similar to the one in my plant. It may fit *EEC's* needs.

Utilities maintenance consists of general and well-equipped shops. This department is responsible for the installation, relocation and removal of all utilities such as process lines, steam, compressed air, refrigeration, ventilation, electricity, water and drainage. Utilities maintenance is also called on to repair, or aid in repairing, heavy equipment.

Specialized maintenance, peculiar to the production department, is concerned mainly with regular inspections and lubricating equipment. Maintenance and repair of special departmental equipment may also require a special skill. For example, in a sewing machine department, a sewing machine mechanic is a special department mechanic, not a utilities mechanic. He repairs defects peculiar to sewing machines. But if the trouble is in a large electric motor, he contacts utilities maintenance to make the repair.

Since the goal of any plant is quality production at minimum cost, cost-conscious management keeps track of overhead expenses. Maintenance is a part of this expense.

L E POLIKOFF, *Brooklyn, N. Y.*

Decentralized system has advantages

If maintenance crews are properly instructed, the decentralized system has important advantages.

Departmental crews don't have to be as skilled as centrally operated crews because they work on fewer different kinds of equipment. Also, since they don't cover a sprawling area, they have more on-the-job time.

Departmental supervisors are likely to give better cooperation to their own group because they know these men. And since the cost of departmental crews is easy to connect with a specific department, supervisors have an incentive to keep the group as small and as efficient as possible.

EEC might do well to establish a little friendly rivalry between departmental maintenance groups.

A compromise would be departmental crews with centralized maintenance purchasing, budgeting and billing.

C G HOWARTER, *Canton, Ill.*

Central system saves money

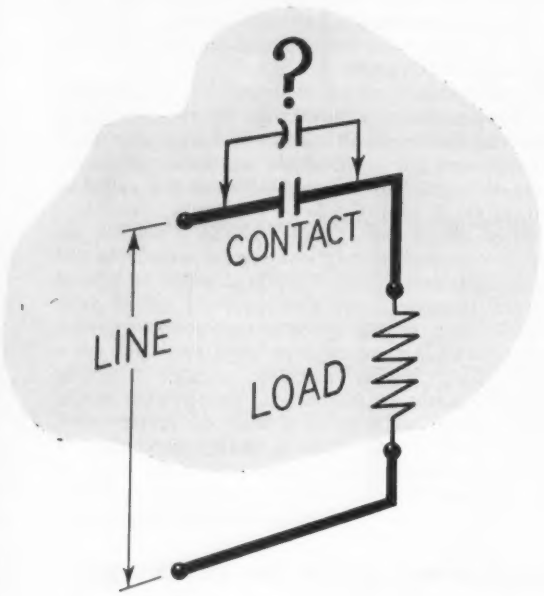
Centralized maintenance would serve the entire plant more efficiently and save money. When necessary, the whole maintenance crew, or any part of it, can be put on production equipment repairs in any of the departments thus avoiding losses from prolonged equipment shutdowns.

Under normal circumstances, the men can be used as needed in each department, or in utilities maintenance. Production equipment maintenance is charged to the department in which the work is done. Utilities-maintenance cost is divided equally between the departments.

F C JACKSON, *East Lynn, Mass.*

Turn page for info on contact pitting ►

More PLANT PROBLEMS Begins on page 142



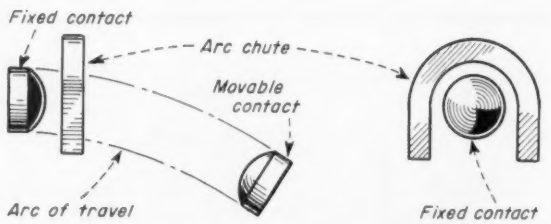
The problem

Can I stop contact pitting with capacitors?

I'm having trouble with switch contacts and thermostat contacts burning and pitting. It happens on a 12-volt 40-watt dc clutch and on a 400-watt 230-volt 60-cycle ac strip heater. As a result I must frequently replace the contacts.

Can I improve contact life by connecting a capacitor in parallel across the contacts? How can I choose capacitor size?—*MT, February Power*

The solutions



Install an arc chute

From a practical viewpoint, *MT* would probably get best results by installing an arc chute. These chutes can be made of four or five layers of thin copper plates, with alternate layers of an insulating material such as mica. The chute should be cut in a horseshoe shape, sketch above, and placed around the path of the contact. There are several manufacturers of electrical equipment who install these chutes in new units.

Naturally, the chutes must be installed so that arcing can't take place between the contact and the chute.

R E Driscoll, *Channelview, Texas*

What MT should know

In general, there are at least four accepted ways to prevent contact pitting: (1) Increase current ratings of switches. (2) Use double- and triple-pole switches instead of single pole. (3) Use oil-immersed or quick-acting switches. (4) Use mercury switches.

The clutch. Although dc is used, when clutch is demagnetized a high voltage discharge due to induction causes damage to contacts. Current rating is low, only 3.33 amps (according to info given and Ohm's law). A discharge resistor of about 3.5 ohms, should be connected across coil terminals. This will correct the problem. Controllers for magnetic clutches often have this discharge resistor built into them.

The strip heater. Current rating at values given indicate only 1.73 amps. Any switch with a rating in excess of this figure should not cause any trouble.

L E Polikoff, *Brooklyn, N. Y.*

MT may have poor contact

A feature of any switch is to get low resistance contact when in the closed position. If contact is poor, high resistance results. This leads to overheating of the switch with possible circuit breaking by overload protective devices.

Switches are designed to give clean, low resistance contact by having the contacts close under sliding or rolling pressure action. Thus, surfaces are sometimes silver-plated, to prevent oxidation, lower contact resistance.

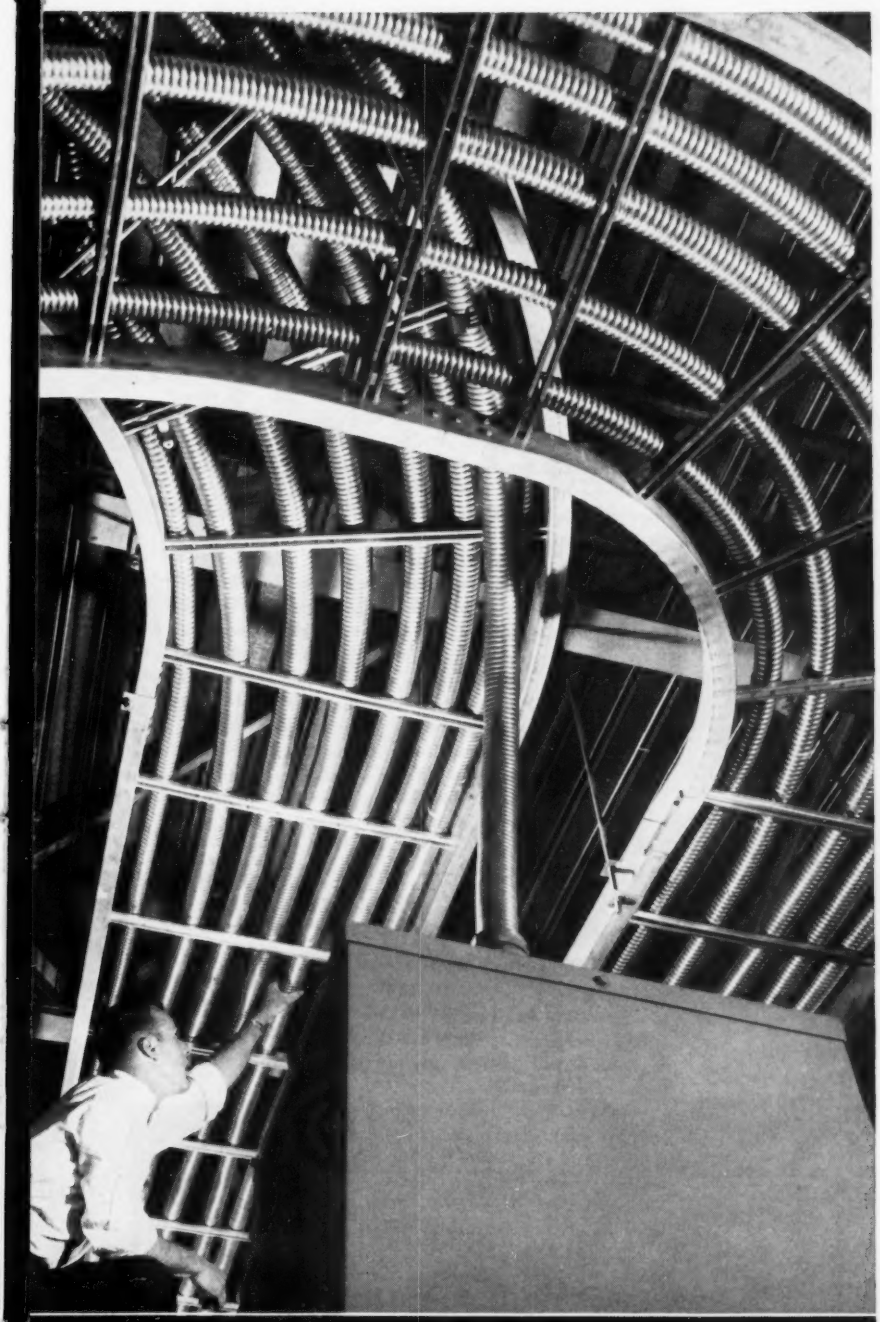
MT should replace his contacts with units of the right design. They will eliminate need for capacitors.

H B Wayne, *Woodhaven, N. Y.*

For more on contact pitting and new questions, turn page ▶

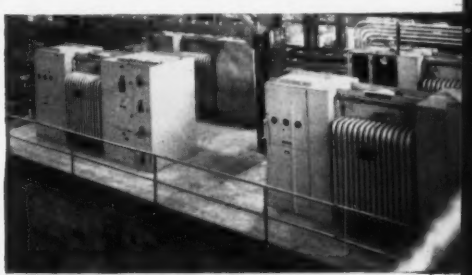
FLEXIBLE

PREPARE NOW FOR FAST-CHANGING PRODUCTION NEEDS WITH A GENERAL ELECTRIC POWER DISTRIBUTION SYSTEM



Changing plant layouts and ever-growing electrical loads make flexibility a "must" in your power distribution system. Easy to relocate, G-E interlocked armor cable helps your plant meet shifting loads without major alterations in the original system. Contact your nearest General Electric Apparatus Sales Office, or send coupon below, for assistance in your system planning.

FLEXIBLE plug-in busway allows easy rearranging of production equipment. Runs have power outlets located every 12 inches.



FLEXIBLE load center systems increase plant capacity efficiently, eliminate long, high-loss secondary feeders when load is added.

To help make your plant's power distribution system:

● **FLEXIBLE** ● **RELIABLE** ● **SAFE**
● **ECONOMICAL** ● **EXPANSIBLE**

Write to General Electric Co., Section B680-6, Schenectady 5, N. Y. for:

☐ **G-E Power Distribution Library**

☐ **Information on color movie "Goodbye Steve", the industrial power story.**

NAME _____

COMPANY _____

ADDRESS _____

GENERAL ELECTRIC

More PLANT PROBLEMS Begins on page 142

MT can use a capacitor in parallel with contacts

MT should bear in mind that with dc coils it's the breaking or sudden interruption of the dc circuit that induces high momentary emf, causing contact pitting.

MT can use capacitors in parallel and across the contacts, providing the plant insurance carrier or local authorities don't object. If they do, a special blow-out coil and short-circuiting device should be installed.

Capacitor size may range from 3 to 10 mfd. We've used them successfully on dc brakes, cluthes and appliancces. Caution: The capacitor must be the oil-impregnated, not the electrolytic, type.

Concerning the strip heater, *MT* can't use a capacitor in parallel and across the thermostatic contacts to minimize contact pitting. Installing a capacitor on this ac application would only create other operating problems. Perhaps *MT* should check with the thermostat manufacturer. It's possible that the stat wasn't designed for the right current carrying capacity and voltage.

Or could it be that *MT* has ac and dc in his plant? If the operator plugs this ac-only appliance into a dc outlet, it will ruin thermostat contacts. This may sound funny but it happened in our plant. We licked the problem by using different types of outlets for dc and ac appliances.

Perhaps *MT* can incorporate a small magnetic contactor in conjunction with the thermostat. This would definitely eliminate his strip heater contact problem.

C BACHMANN, *Jamaica, N. Y.*

Install capacitor on line side of the breaker

Capacitors are used to correct voltage on large distribution circuits or on small motors to prevent serious voltage drop on starting load.

The pitting can be caused by the same culprit that ruins the points on your car. Try putting a capacitor on the line side of the breaker. The equipment manufacturer will be glad to tell you which size and type to install.

W A WYBORN, *Alberta, Canada*

Equipment maker can tell you best capacitance values

Contact troubles occur on low-voltage dc circuits when a high-voltage induced current develops as circuit is broken. Arcing can take place with a minimum current of 0.05 to 1.5 amps at from 9 to 20 volts, depending on the type of contact material.

Controller or switch must be designed so a capacitor can be shunted across the contacts an instant before the circuit is opened. This will cause induced voltage to charge the capacitor and avoid arcing across the gap of the contact.

Check with the manufacturer of your equipment for best values of capacitance to use when shunting across contacts.

L ZIDEL, *Brooklyn, N. Y.*

Try mercury switches

Using capacitors may help *MT*, but usually capacitors aren't needed and aren't used. I suggest that he check size of the switch controllers. Also, condition of supply voltage and coils. Trouble may lie here.

Alternate suggestion: Try mercury switches.

E A ROBERTS, *Carlsbad, New Mexico*

Your May problems

What caused turbine thrust bearing damage?

A 70-mw turbine-generator is fed by two boilers producing 290,000 lb steam per hr. With the first boiler at 940 psi, 914 F, generator output was 30 mw.

Second boiler pressure was 925 psi, temperature 875 F, and water level a little below half full. After operating conditions had been carefully checked, second boiler was put on the line. Its water level went a little above half full and generator output rose to 32 mw before trouble occurred.

The steam turbine sustained a shock and the generator lost 12 mw almost immediately. Pressure of the second boiler rose to 940 psi. Operator immediately reduced it. At the same time the minimum bearing clearance alarm operated and its oil temperature went from 130 F to 135 F. Then the height eccentricity alarm between turbine stator and rotor operated but only instantaneously. The recorder showed that the turbine shaft was displaced 1.5 millimeters on the l-p side, along the axis.

Under these conditions the units were shut down.

When the thrust bearing was removed it appeared damaged, with considerable material carried away. What could have caused this trouble?—*WF*

Should we use a synchronous or induction motor?

In expanding our process we must add several blowers in the plant. These units are 350 horsepower each, and will require motors with a synchronous speed of 900 rpm.

We have never been penalized by our local power company for too low a power factor so we wouldn't go to synchronous motors for this reason alone. But we are wondering which we should choose, synchronous or induction motors. We naturally want to consider first cost, operating cost and efficiency.—*HEC*

Sit down right now and answer one or both problems.
We'll pay extra for answers with photos, sketches.

"Used many makes of turbines... PREFERS COPPUS"

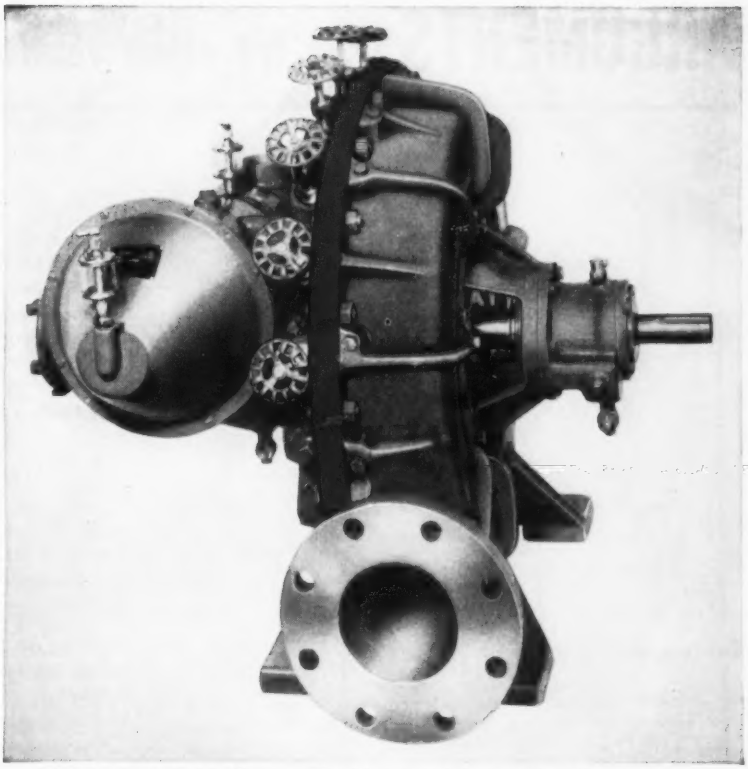
If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

> "I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

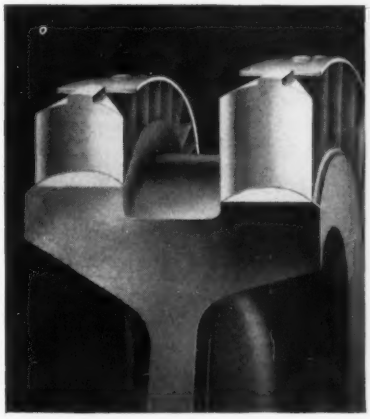
Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
165 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER



This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.



This wide bucket "L" type wheel is a new development for use where low water rate is essential

This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.

COPPUS "BLUE RIBBON" TURBINES

ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*

Do we need more licenses?

Some operators say *no*, but according to our 32-page special report on *License Requirements*, published in 1950, the following 64 cities and states have licensed operators in stationary steam plants. Are there more now? Should there be more?

I believe there should, and I am revising the report mentioned above. POWER readers can help by looking over this list carefully and letting me know of any new locality having license requirements since this list was published.

Alabama—Mobile
California—Los Angeles, San Diego, Santa Barbara
Colorado—Denver, Pueblo
Connecticut—Bridgeport, New Haven
Delaware—Wilmington
District of Columbia
Florida—Tampa
Georgia—Fulton County
Illinois—Chicago, Decatur, E St. Louis, Elgin, Evanston, Oak Park, Peoria
Indiana—Hammond, Terre Haute
Iowa—Des Moines, Sioux City
Kentucky—Covington
Louisiana—New Orleans
Maine—State license
Maryland—State license
Massachusetts—State license
Michigan—Bay City, Dearborn, Detroit, Saginaw
Minnesota—State license
Missouri—Kansas City, St. Joseph, St. Louis
Montana—State license
Nebraska—Lincoln, Omaha
New Jersey—State license
New York—Buffalo, Mt. Vernon, New York City, Niagara Falls, Rochester, Yonkers
Ohio—State license
Oklahoma—Oklahoma City, Tulsa
Pennsylvania—Erie, Philadelphia, Pittsburgh
Rhode Island—Providence, Woonsocket
Tennessee—Memphis
Texas—Houston
Utah—Salt Lake City
Washington—Seattle, Spokane, Tacoma
West Virginia—Huntington
Wisconsin—Kenosha, Milwaukee, Racine

Here's where to send your comments:
STEVE ELONKA, POWER, 330 W 42nd St, New York 36, N. Y.

Reversed open-delta voltage

Bachmann asks. I was interested in L McWilliams' article about reversed open-delta transformers, POWER, Sept 1956, p 122. But I would like to know how he got 208 volts on the center phase of a 120-volt closed-delta transformer, reconnected to open delta.

My experience shows that reconnecting a closed delta to open delta is done only in emergencies. Assuming a 1000-kva closed-delta transformer bank, reconnecting to open delta could only deliver about 575 kva, not considering other reasons for not doing this.

As a matter of fact, I believe the 3-phase 4-wire or star-connected transformer will eventually replace most other transformer connections.

CARL BACHMANN, *Kew Gardens, N. Y.*

McWilliams explains. When two transformers of opposite polarity are connected in the conventional manner, or when two transformers of the same polarity are connected wrongly, we get a 180-deg phase shift. Then resultant voltage E equals 2 times cos 30, times the phase voltage across the open legs. For a 120-volt transformer, this works out to 2 times .86603 times 120, or 208 volts on the center phase.

Supposing we had a reversed open delta on a 550-volt secondary winding. Voltage on the open legs would be 550 times 1.732, or nearly 950 volts.

True the open delta is used only in emergencies and you get only 57.7% of the bank rating. But we have had to use the connection many times.

L MCWILLIAMS, *Shawinigan Falls, Que.*

Feed pumps require drive power

I disagree with the statement, "Under favorable conditions, use of a turbine drive (for boiler-feed pump) permits releasing . . . energy to salable kilowatts," POWER, Jan 1957, p 101. This gives the impression that you get more station output at no extra cost.

Total generating equipment output must be system load plus power required for all purposes within the plant. If you select motor-driven feed pumps, you must add enough capacity to turbines and generators to operate them. If they are driven off the shafts of the main generating units, the power required must be added to the turbines, without need for increasing generator output. For separate turbine drives, extra power is provided in the pump turbines.

For a given power station, designer must select the feed-pump drive with most all-around advantages.

H T LIVINGSTON, *Los Angeles, Calif.*

(Advertisement)

One of a series.

An Inside Peek at Steam Trap Capacity Ratings

or... how to be sure steam heated equipment is going to work the way it's engineered

WHEN YOU GET all through engineering a steam heated process equipment installation, its performance will depend on whether your steam traps will do what the catalog said.

Now, in theory, if you know the size of a steam trap orifice, you can figure how much water can be pushed through it in a given time by a given steam pressure. But, in practice, this doesn't work out. The picture is scrambled by things like the choking effect of flash steam and restriction of flow through the trap and piping.

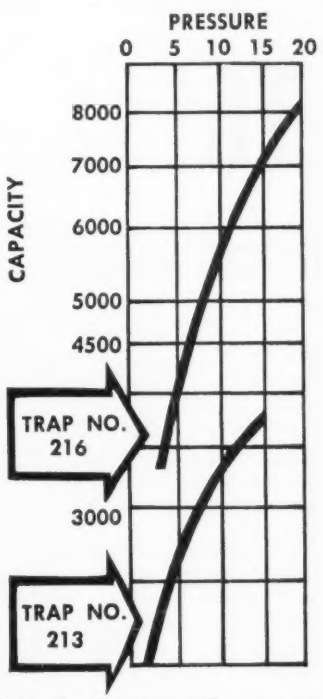


Fig. 1—Showing difference in volume of condensate discharged by a No. 216 trap with 2" pipe connections and a No. 213 trap with ¾" pipe connections—each trap having ½" discharge orifice.

For example, Fig. 1 shows that a ½" orifice in a 125 psi No. 216 Armstrong steam trap with 2" pipe connections will discharge 7200 lb/hr condensate at 15 psi inlet pressure. Yet, a ½" orifice in a 15 psi No. 213 trap with ¾" pipe connections, discharges but 3900 lb/hr at 15 psi inlet pressure. The difference: pipe friction.

Thus, we see a need for investigating the basis for steam trap capacity ratings. Unfortunately, they are not all arrived at in the same way. If they are based on cold water tests, producing no flash steam, they are much too high. Orifice tests are also too high because they ignore pipe friction. Calculations involving flow-through-orifice formulae have never been known to be conservative insofar as traps are concerned.

Armstrong Ratings

Armstrong trap capacity ratings are based on actual operating conditions, determined by hundreds of tests. In these tests condensate at the steam temperature corresponding to test pressure was used. Restriction of flow caused by the choking effect of flash steam, as well as the back pressure created by flash steam and condensate, automatically were taken into account. Actual installation hookups were used, so that pipe friction in both inlet and discharge lines also was reflected in the results.

All this effort assures you the nice, comfortable feeling that comes from knowing a trap will deliver on the job the full capacity claimed in the catalog.

* * *

There is one more ingredient that needs to be tossed into the trap-sizing pot. This morsel is the safety factor—the required excess of trap capacity over calculated condensate load. It will be the subject of the next advertisement in this series. But, in the meantime, if you'd like to get the lowdown, ask for a copy of the 44-page Armstrong Steam Trap Book. It is a complete guide to good trapping practice. It covers not only safety factors, but calculation of condensate loads and trap selection, installation, troubleshooting and maintenance. Just call your local Armstrong Factory Representative, or write: **Armstrong Machine Works, 8125 Maple St., Three Rivers, Michigan.**

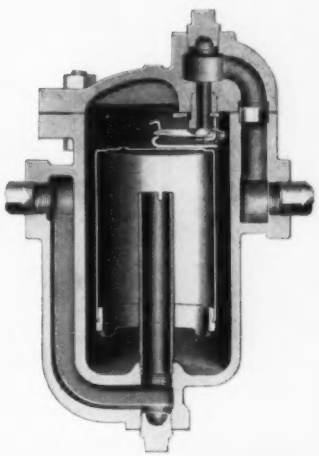
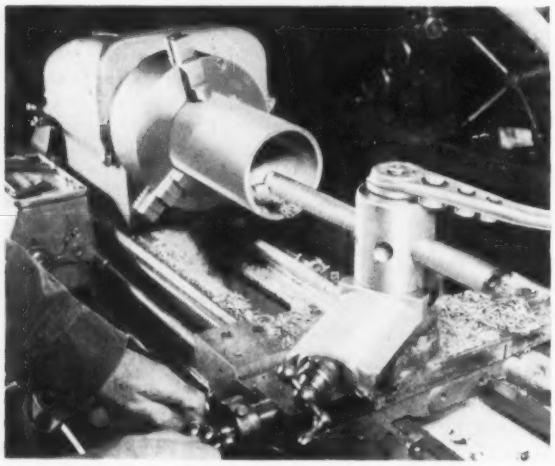


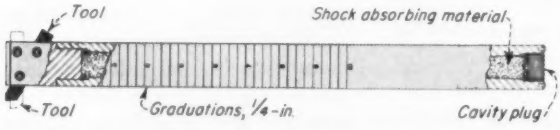
Fig. 2—Armstrong inverted bucket steam trap—hardened chrome steel valve and seat—stainless steel lever and bucket—simple, dependable, long-lived.

ARMSTRONG STEAM TRAPS

BIGGER CUTS at faster speeds is outstanding feature of this new chatterless bar. Its design is based on the science of harmonics



OVERHANG is 'duck soup' for boring bar—even if cut is very heavy and work turns fast—because bar is correctly designed



DEAD BAR has tapered hole from both ends, shock-absorbing material pulled inside under vacuum. Result: no chatter

HOW TO

Bore chatterless holes

► NOW, MAINTENANCE MEN can take bigger cuts and run work faster with this new chatterless boring bar. Known as *Silent Sam*, it's the first scientifically designed boring bar based on the science of harmonics.

Inside of bar, sketch, is bored out from both ends to a hole of various diameters, with smallest diameter in center of bar. Hole's shape helps diminish harmonic vibration to a minimum. Diameters were determined by using a vibration meter and probing bar at every quarter inch. Cavity is filled with a shock-absorbing material, under vacuum. This construction gives you a *dead* bar of superior strength. The special alloy metal also plays a big part in enabling you to take bigger cuts, at faster lathe and boring mill speeds. Also, the hole bored is smoother.

Bar's outside has ¼-in. graduations so you can see depth of bore, without measuring with scale. Tests show that time saved in doing jobs pays for bar in a very short time.

—Courtesy, Pensco Products, 527 Lexington Ave, N.Y.C.

Midwest institution gets lesson in turbine lubrication

. . . learns advantages of using NONPAREIL *Turbine Oil*

In 1939, a Midwestern institution installed a 350 kw. turbine. In less than a year, considerable difficulty was experienced with oil sludge and deposits. A Standard Oil Company industrial lubrication specialist recommended switching to NONPAREIL Turbine Oil as a solution to the problem. He supervised the draining and cleaning of the turbine system and the installation of NONPAREIL Turbine Oil.

The turbine, equipped with NONPAREIL, was started up in June, 1941. Periodic tests showed that the neutralization number of the oil was never above 0.06 mg. KOH/g. Having had this experience with NONPAREIL Turbine Oil, when a new 750 kw. turbine was installed in 1947, only NONPAREIL was considered. In 1954 when a 1,000 kw. turbine replaced the 350 kw. one installed in 1939, NONPAREIL was again the first choice of the institution management.

The reason why NONPAREIL can deliver this kind of performance is this: NONPAREIL is refined from finest quality oil. An oxidation inhibitor is added to NONPAREIL which checks acidity formation even better than natural inhibitors normally found in oil. The inhibiting of acid formation in NONPAREIL is so complete Standard Oil can guarantee that the neutralization number of NONPAREIL Turbine Oil will never exceed 0.15 mg. KOH/g. for the life of the turbine.

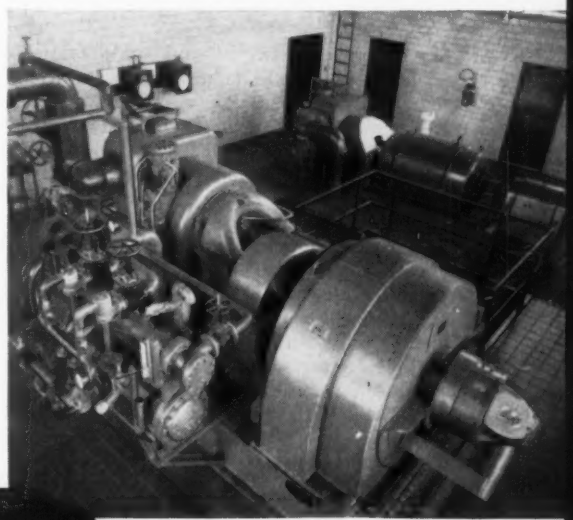
More facts about NONPAREIL Turbine Oil are readily at hand. Get them from your nearby Standard Oil industrial lubrication specialist. There is one of these men in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Quick facts about

NONPAREIL TURBINE OIL

- Does not form acids.
- Does not sludge.
- Maintains good demulsibility.
- Guaranteed to last the life of the turbine.

A 1,000 kw. and a 750 kw. turbine provide power to this Midwest institution. Both have used NONPAREIL Turbine Oil since the first day they went into service.



Donald Cripps (right), Standard Oil lubrication specialist, hands John Edyvean, plant superintendent, framed guarantee for NONPAREIL Turbine Oil. Providing technical service on lubrication problems is work for which Don Cripps is well qualified. He's been doing it for nine years at Standard. In addition, he has an engineering degree from Michigan State University and is a graduate of the Standard Oil Sales Engineering School.

STANDARD

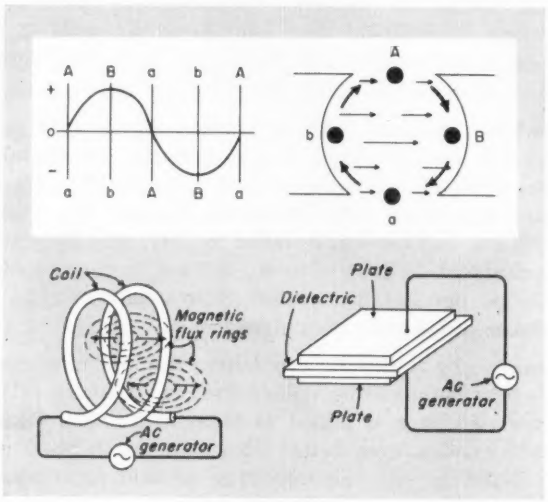
STANDARD OIL COMPANY
(Indiana)

BASICS . . . *bringing engineering theory down to earth*

NORMAN PEACH, *Assistant Editor*

Electricity: 10

Why alternating current is different



► ALTERNATING CURRENT reverses its direction at regular intervals. Looking at the dc generator in last month's *Basics* you'll see that an alternating electromotive force is generated in the coils, and then the alternating emf is turned into a direct emf by the commutator. If instead of the commutator, two solid separate rings *(slip rings)* are used, the alternating emf can be brought out and an alternating current will flow in the external circuit.

When a generator coil is moving parallel to the magnetic flux, as is coil in position *Aa*, top sketch, zero emf is induced in the coil. As coil rotates it cuts flux at increasingly steep angles, and emf goes up. (March *Basics*, p 148.) In position *Bb* coil is cutting flux at right angles, emf is a maximum. Emf decreases until at position *aA* it is zero again. Then the emf increases in the opposite direction until it's a maximum at *bB*, and decreases to zero when coil is back in original position *Aa*. This sequence, in which the coil rotates through 360 deg, is called a *cycle*.

Frequency is number of cycles per second; thus a 60-cycle alternating current repeats the sequence, zero-positive maximum—zero-negative maximum—zero, 60 times every sec. The curve representing an ideal alternating emf or current is called a *sine wave*. Its name comes from the mathematical law relating to a curve produced by a point moving in a circular path in the manner that the generator coil moves.

Two properties of alternating current are not associated with continuous direct current. They are *inductance* and *capacitance*. (Inductance is important in dc circuits only when closing and opening the circuits.) Because ac varies from zero to maximum, the magnetic flux rings surrounding the conductor continually build up and collapse. This flux can induce an emf in an adjacent conductor, as was described in March *Basics*. Note that the induced emf is in the *opposite direction* to the current that produced it. Now if the second conductor is in series with the first, the induced emf will oppose the flow of current in it. Such an opposite emf reduces the current in a circuit as though additional resistance were inserted in it.

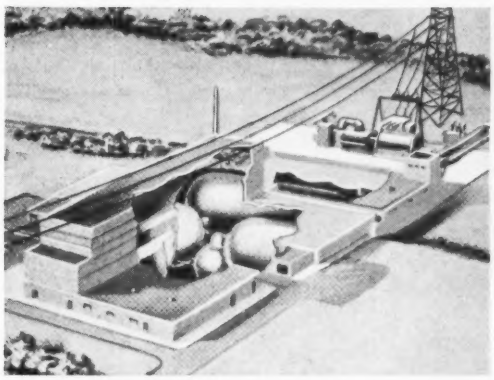
This type of opposition to current flow is known as *inductive reactance*. A coil of many turns will have high inductive reactance, but even a single conductor has some since magnetic flux rings expand outward from its center and therefore cut across the conductor. Ability of a circuit to produce inductive reactance at some frequency is called its *inductance*. (For a circuit with a particular inductance, the inductive reactance will increase as frequency increases.) Inductance depends on number of turns in the circuit, whether magnetic field is in air or iron, etc.

Capacitive reactance is another form of opposition to current flow in ac circuits. It comes from the presence of *capacitors* (condensers) in the circuit. A capacitor consists of two conductors separated by an insulating material or *dielectric*. The two conductors, usually in the form of plates or strips of foil, are connected in the circuit in such a way that one plate is positive while the other plate is negative. The negative plate has an excess of electrons and the positive plate has a shortage of electrons. Because opposite electric charges attract each other, more electrons will move from the negative plate to the positive plate until maximum charge for the particular capacitor is reached. If a dc voltage is applied to the capacitor, current will flow momentarily while the capacitor is charged, and then current will stop. But if ac voltage is used, current (electrons) will flow in and out of the capacitor. Alternating current thus behaves as though it flowed through the capacitor; the apparent opposition to this flow is the capacitive reactance of the circuit. The ability of a circuit to produce capacitive reactance at a particular frequency is called its *capacitance*. Capacitive reactance decreases as frequency increases. Capacitance in power circuits is usually present because a capacitor has been included in the circuit for some reason, but under certain circumstances "natural" capacitance resulting from adjacent insulated conductors can be large enough to have significant effect.

Ac circuits can contain resistance, inductive reactance, or capacitive reactance, or combinations of these. They can't simply be added by arithmetic. (This will be taken up in the next *Basics.)* Total opposition to current in ac circuits is *impedance*. Impedance Z takes place of R in Ohm's law.

Next month's Basics: How to calculate impedance.

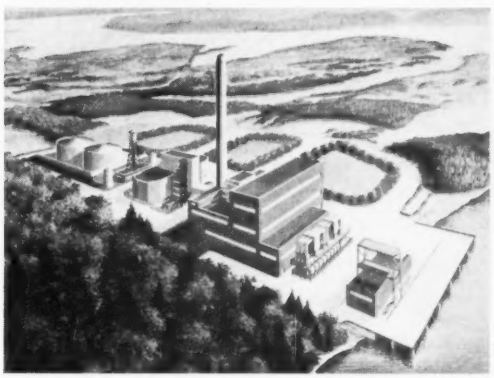
Three of America's LARGEST ATOMIC POWER PLANTS will use MAJOR COMPONENTS* by FW



60,000 KW SHIPPINGPORT PLANT
of the AEC and Duquesne Light Company

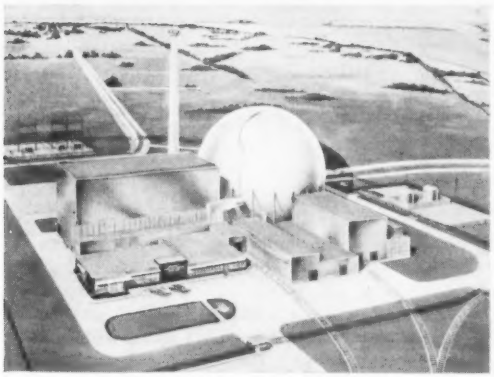
***Steam Generators.** Two of the four steam generators for America's first full scale commercial atomic power plant have been designed and fabricated by Foster Wheeler. They will convert heat from the pressurized water reactor into steam for operating the turbo generator.

***Pressurizer.** Also supplied by Foster Wheeler is the 18-ft high, 300 cu ft pressurizer used to maintain coolant loop pressure. It is designed for 2500 psig at 675 F and contains 342 electric immersion heaters for controlling operating pressure.



236,000 KW INDIAN POINT PLANT
of the Consolidated Edison Company

***Separately-Fired Superheaters.** Saturated steam from the pressurized water reactor will be superheated from 447F to 1000F by two Foster Wheeler oil-fired superheaters, each with a capacity of 1,075,000 lb/hr at 410 psia. Compared to operation with saturated steam direct from the reactor, addition of the superheat cycle will raise plant capacity from 140,000 kw to 236,000 kw and reduced estimated plant cost from $322 to $233 per kw.



180,000 KW DRESDEN STATION
of the Commonwealth Edison Company

***Primary Steam Separator.** Primary steam generated in the reactor will be separated from the water in a Foster Wheeler steam drum designed for a pressure of 1250 psia and capable of delivering 1,400,000 lb/hr at 1000 psia with a moisture content of not over 0.1%.

***Secondary Steam Generators.** Primary nuclear heated water will be converted to secondary steam for a reduced-pressure turbine stage by four Foster Wheeler steam generators with a combined capacity of approximately 1,190,000 lb/hr at 510 psia saturated.

IN addition to the above major nuclear components, Foster Wheeler know-how encompasses the design and fabrication of complete nuclear power plants of the aqueous homogeneous reactor type as well as specialized tank-type research reactors.

For further details on any of these items, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

"Before I tell you my theory," roared Marmy, "relax and have a can of beer."

Marmy's beer can science

► Bedlam's Bent Propeller Bar over in the Hell's Kitchen section of Manhattan was very quiet when I dropped in at noon. But I struck gold, for at a corner table sat Marmaduke Surfaceblow, that outstanding consulting engineer. With his gray bowler shoved back over his shock of white hair, the old gent was busy ballasting his holds from a huge plate of corn beef and cabbage. Between sling loads of vittles, he'd work up a high vacuum on his ballasting pump. Then he'd top off his double bottoms from a bottle of Sandpaper Gin.

Eating with him were his old shipmates, George Bedlam and Mike O'Houlihan. Bedlam invited me to join them. That I did, hoping Marmy would sound off so I could get another yarn into print for you loyal readers.

"Just flew back from the Heating & Air Conditioning Show in Chicago," I announced, after ordering a short beer. "And I saw some interesting heat pumps for year around space conditioning."

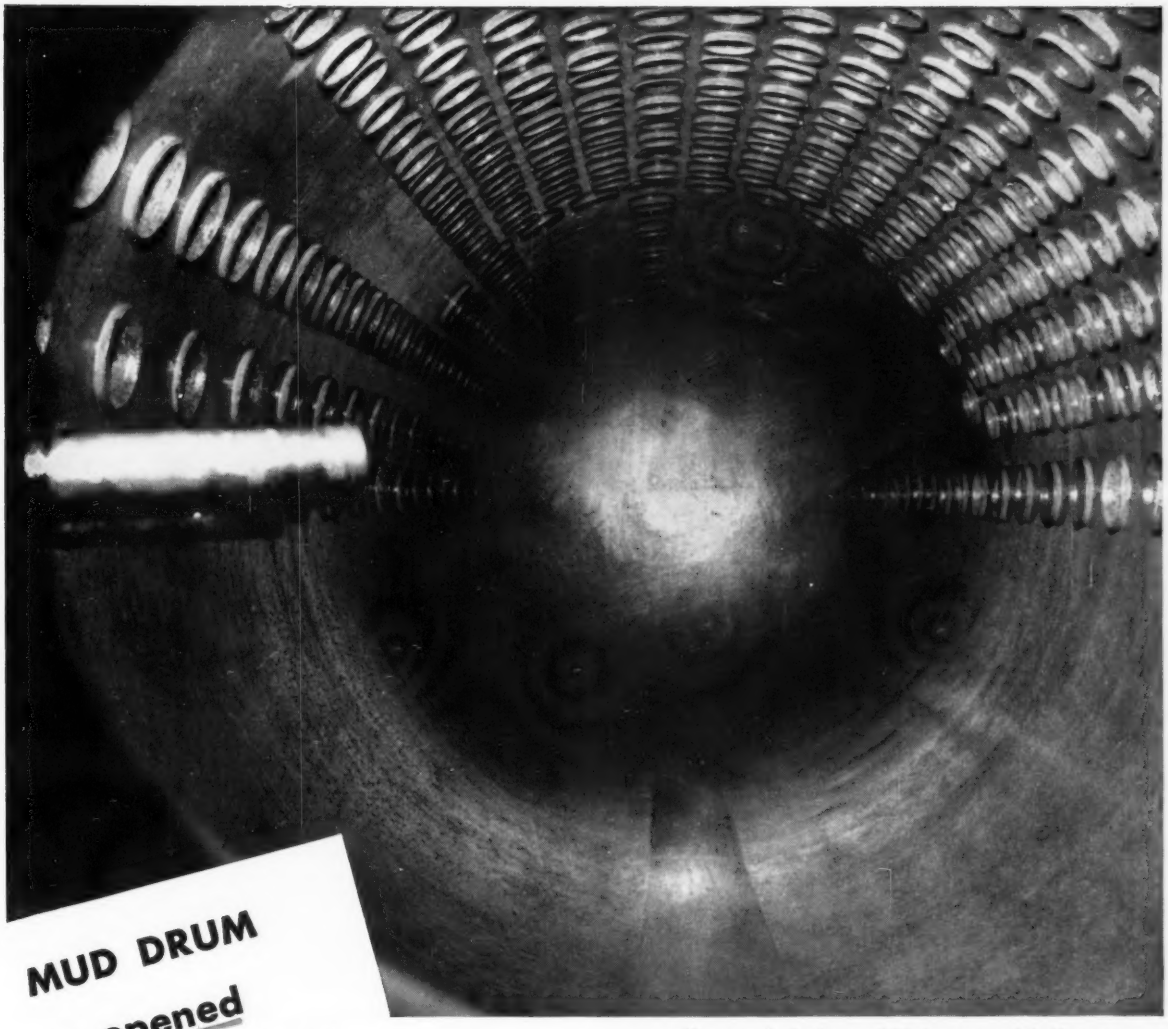
"Bilgewater on heat pumps, vacuum pumps and sump pumps," roared Marmy in his foghorn voice. "I'll tell you guys about the time I unfouled a fuel-oil heating system that wouldn't supply enough oil. And all I did was drink a can of beer." Having made that unusual statement, the cantankerous old gent lit up a piece of rope yarn, leaned back in his chair and blasted away in his gravelly voice.

"Back in 1947 while on the beach in Providence, R. I., I heard about a fuel-oil pumping problem in a local factory building. I needed some ready cash so I dropped into the plant's office. The building manager was happy to hear that I thought I might be some help.

"He had three hrt boilers, recently converted from coal to oil. Boilers were 15,000-lb-per-hr capacity. Their new rotary-cup burners burned No. 6 oil. Two 10,000-gal fuel-oil storage tanks had been place into the old coal bunkers and the tank's suction lines ran down into the tank.

"Each tank had its own fuel-oil system. Pump-discharge pressure at normal load was 55 psi. This pressure was regulated by adjusting the oil relief valves on the oil heaters and burners. Excess oil returned to the storage tanks.

"First three months after converting to oil, the suction had been from No. 1 storage tank. From that tank, the fuel-oil pumps showed a vacuum of 12 in., discharge pressure of 55 psi. Oil temperature in tank had been around 85 F. There was no trouble meeting the heating load, not (*Continued on page* 198)



MUD DRUM
as opened
after one year
on line
with
THE *Nalco* SYSTEM

Unretouched photo of Nalco treated boiler at Georgia Institute of Technology, Atlanta, Georgia

● Calling this a mud drum serves only to identify its location . . . it is perfectly clean after a full year on line. The unretouched photo was taken immediately after the drum was opened. No wash-out was necessary. Not only is the drum free of scale and corrosion . . . Nalco sludge conditioning operated so effectively that even under the static, off-line draining condition, no sludge deposited in tubes or drums.

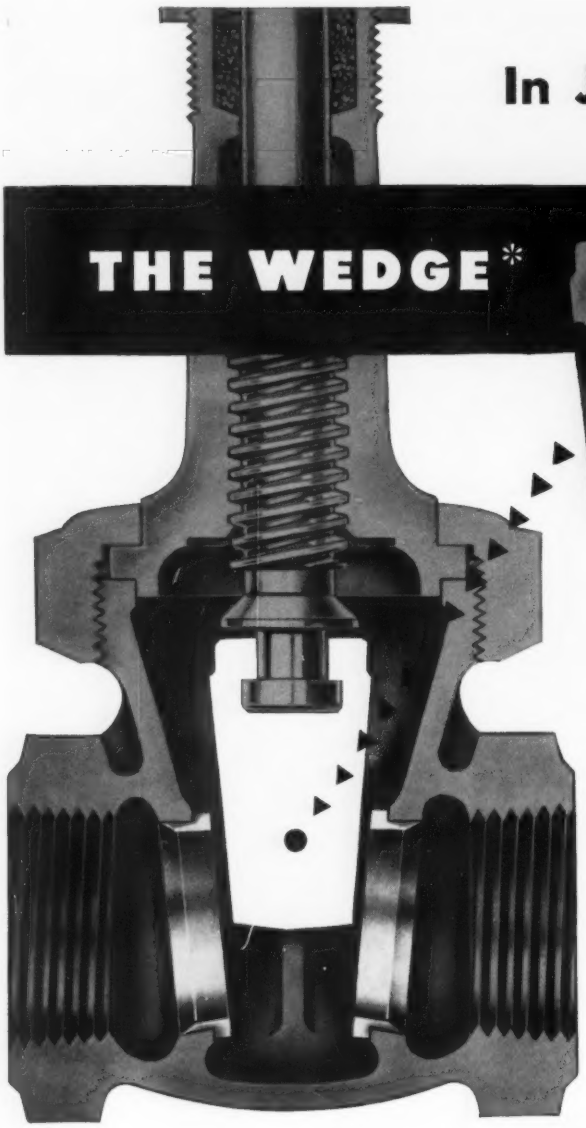
The Nalco System can get results like these, economically, in *your* plant—regardless of boiler size or pressure. Write or phone Nalco today for action on a complete water treatment program.

NATIONAL ALUMINATE CORPORATION
Telephone: POrtsmouth 7-7240
6222 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*® SYSTEM . . . Serving Industry through Practical Applied Science

In JENKINS Monel-Seated

THE WEDGE* TAKES THE



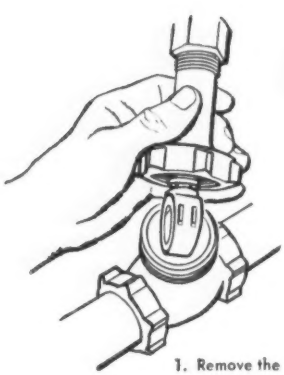
THE RENEWABLE WEDGE (bronze or nickel alloy) has excellent wear resistance, but has a lower degree of hardness than the heat-treated Monel rings, which have optimum resistance to erosion and corrosion as well as abrasion. Thus, wear of the wedge leaves the rings relatively unaffected.

***MADE WITH BRONZE OR NICKEL ALLOY WEDGE** The bronze wedge provides lasting economy for most applications. The nickel alloy wedge provides extra resistance where severe abrasion or corrosion are factors.

JENKINS BRONZE GATES WITH MONEL SEAT RINGS

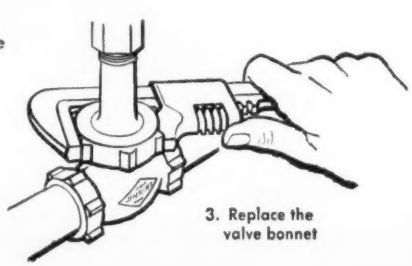
200 psi	300 psi
Fig. 270-U, Bronze Wedge	Fig. 280-U, Bronze Wedge
Fig. 270-UN, Nickel Alloy Wedge	Fig. 280-UN, Nickel Alloy Wedge
Fig. 270-UL, Bronze Wedge, U. L. approved for L.P.G. Services	350 psi Fig. 280-UX, Bronze Wedge

Replace the wedge only — in minutes — right on the line — to restore full efficiency



1. Remove the valve bonnet

2. Slip worn wedge off the stem, and slip on new wedge



3. Replace the valve bonnet

Bronze Gates

WEAR-AND SPARES THE RINGS

The Monel Seat Rings are in to stay — expanded-in — to last for full life of valve. Here's why . . .

INSTALLING SEAT RINGS in a gate valve is a job for experts, even when it's new. But look into a valve (like the one shown here) that has been in service long enough to need part replacement . . . the kind of tough, punishing service that Monel-seated gates are designed for. You'll see why Jenkins valve specialists decided to provide practical, fast, economical renewability by simply changing the wedge, — *not the rings.*

IN JENKINS MONEL-SEATED GATES, the seat rings are expanded into the body to assure a positive, leak-proof joint. This permanent, all-around support of the rings is essential to guard against deforming, loosening, or shifting under the most severe conditions of service.

GET PRACTICAL, LOW-COST RENEWABILITY along with dependable resistance to wear and corrosion. Compare . . . there is nothing simpler, faster, or more economical than renewal in Monel-seated Gates of Jenkins design . . . and you also get the *plus* of Jenkins *extra value* in every other feature. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS BRONZE GATES INCLUDE 40 DIFFERENT PATTERNS

125 • 150 • 200 • 300 • 350 psi SOLID WEDGE • SPLIT WEDGE
SCREWED • FLANGED • SOLDER END • SOCKET END • QUICK OPENING

Call your local Jenkins Valve Distributor for complete information

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros

SOLD THROUGH PLUMBING - HEATING AND INDUSTRIAL DISTRIBUTORS

Reader service section

Start with these quick samples...

This month's menu . . .

of reading matter starts, like any good menu, with an appetizer—some light reading to sharpen your wits and brighten your mood. Browse through Power Lines—a shortcut to the news—or dig into the lead story on the engineer shortage. Maybe you'll learn something—maybe you won't, but it'll help to clear your mind.

Reports from the field, p 160

Now you're ready . . .

for the next course—technical briefs—a somewhat meatier subject. Incidentally this is a good opportunity for you to inquire into some of the latest technical developments not only in your field, but in the highly exciting new fields that science opens up every day. If after reading the short version, you want the full report, see our directions.

Technical briefs, p 162

Piece de resistance . . .

This is the main dish; the backbone of any reader service section—new plant equipment. This month there are four pages of pictures, specs and descriptions. Perhaps you're interested in electric arc welders or your plant is in need of new meters. Whatever your interest or need, you'll usually find it represented in our pages.

Plant equipment news, p 162

Choice pieces . . .

of literature are spread before you next. These 30-odd bulletins cover subjects from A to Z, beginning with air conditioning and going straight through. If you find something in our ads or new equipment section that appeals to you, check the listing of manufacturers' bulletins. Most likely you'll find a catalog or report on it there.

Free literature, p 175

For dessert . . .

we offer a story with a moral. These stories, spun by our engineer-philosopher, have a universal appeal because they concern everyday people with the same faults and virtues that we have. Perhaps, too, in addition to the enjoyment you cull from reading them, you'll learn to understand yourself and others better.

George Edwards, p 178

For other timely ideas, see following service pages▶

New Revolutionary Steam Trap

One large capacity seat for all pressures!

New Sarco Thermodynamic steam trap. Sizes ⅜ to 1"... each body as small as a tee fitting! Capacity is determined, not by a bulky body, but by the effective orifice, valve action, pressure drop and condensate temperature.

1. Cuts trap inventory

With the revolutionary Sarco TD steam trap, you use exactly the same trap... with exactly the same large capacity seat... for all pressures 10-600 psi... for heavy, light or no condensate load. Sizes ⅜ to 1".

2. All pressures 10 to even 600 psi!

...without changes or adjustments. Self-adjusting. High pressure construction... at a low pressure trap price!

3. Operates perfectly when pressure fluctuates

Absolutely no effect even from 600 to 10 psi! No water seal to evaporate. No adjustments.

4. Widest capacity range

Same large capacity seat for 10 as for 600 psi. Pressures of incoming air and condensate INSTANTLY AND FULLY raises valve head (disc), permitting maximum discharge.

5. Operates equally well on all loads

The same Sarco TD trap for heavy, light or no condensate load. No prime to lose. No adjustments.

6. No oversizing worries

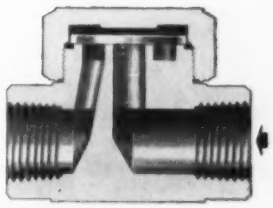
You can size the new Sarco TD steam trap for peak condensate loads... without risk of blowing steam on light loads... no prime to lose... no adjustments.

7. No steam leak required

...to operate the revolutionary Sarco TD steam trap (Pat. Pending). Closes tight against steam!

Convince yourself by 60-day trial... use coupon

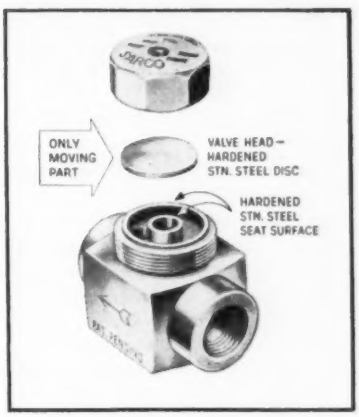
SARCO



Trouble-free design

Here is a trap so simple, it doesn't even have a valve closing mechanism. The kinetic energy of steam closes the valve. ONLY the new Sarco TD uses this operating principle.

No mechanism parts to wear or stick. No narrow channels to choke. No gaskets to leak.



Maintenance practically eliminated

The all-stainless steel Sarco TD has only 3 parts... cap, disc and body. Only moving part is a hardened SOLID stainless steel disc, practically wearproof.

SARCO COMPANY, INC.
Empire State Bldg., N. Y. 1, N. Y.

Please send me Sarco TD Steam Trap and strainer for 60-day trial.
Size_____ For use on_____

Name_____

Firm_____

Address_____

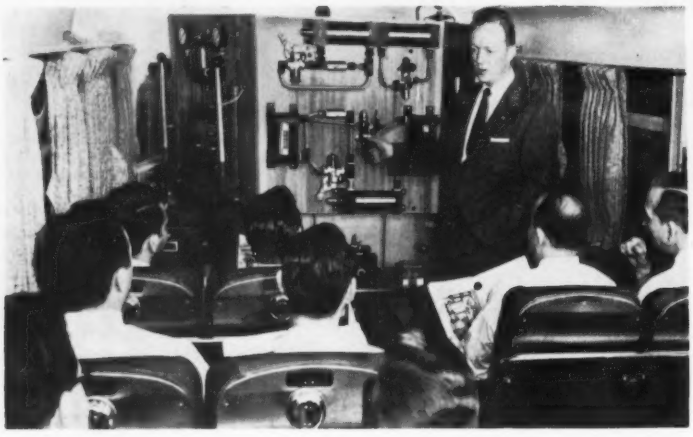
City_____ State_____

2101-B

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 228



Engineers attend school on wheels to bone up on the latest technical data. Bus "colleges" are paying off in fight to keep men abreast of technology

ASME urges new look at shortage

► LONG AGO, Aesop told the story of a dog with a bone, who, seeing his reflection in a pool, resolved to seize the bone he saw there. When he opened his mouth to take it, his own fell into the water and was lost.

This is the predicament in which American industry finds itself, says the American Society of Mechanical Engineers. In searching for a way to relieve the shortage of engineering talent, it overlooks its best asset—the engineer already on the job.

Perhaps, suggests ASME, in a recent survey, industry "may have to revise its battle plans in the fight to relieve the current shortage."

What exactly are industry's plans? Some observers feel the suggestion that industry *has* a plan is a wild overstatement of the case.

Certainly the short-term view taken by some companies is rather primitive. (*Continued on page* 224)

Seaway project gets huge gates

► THE GIANT STEEL SLAB, shown, photo left, is, in reality, one of 48 gates destined for delivery to the site of the St. Lawrence Seaway project.

They have been ordered for the Canadian half of the powerhouse being built in the International section of the river.

The gates, each 17 ft wide by 37 ft high, will be used to cover the three penstock openings to each of 16 75,000-hp propeller turbines.

Each gate has its own local control station, but in an emergency all three on one turbine can be closed simultaneously from the powerhouse.

Power Lines

A new fuel source has been spotlighted by experiments at the University of California. Methane gas, building block in gasoline production, has been obtained from decaying algae. Light energy has thus been converted to energy that can be stored.

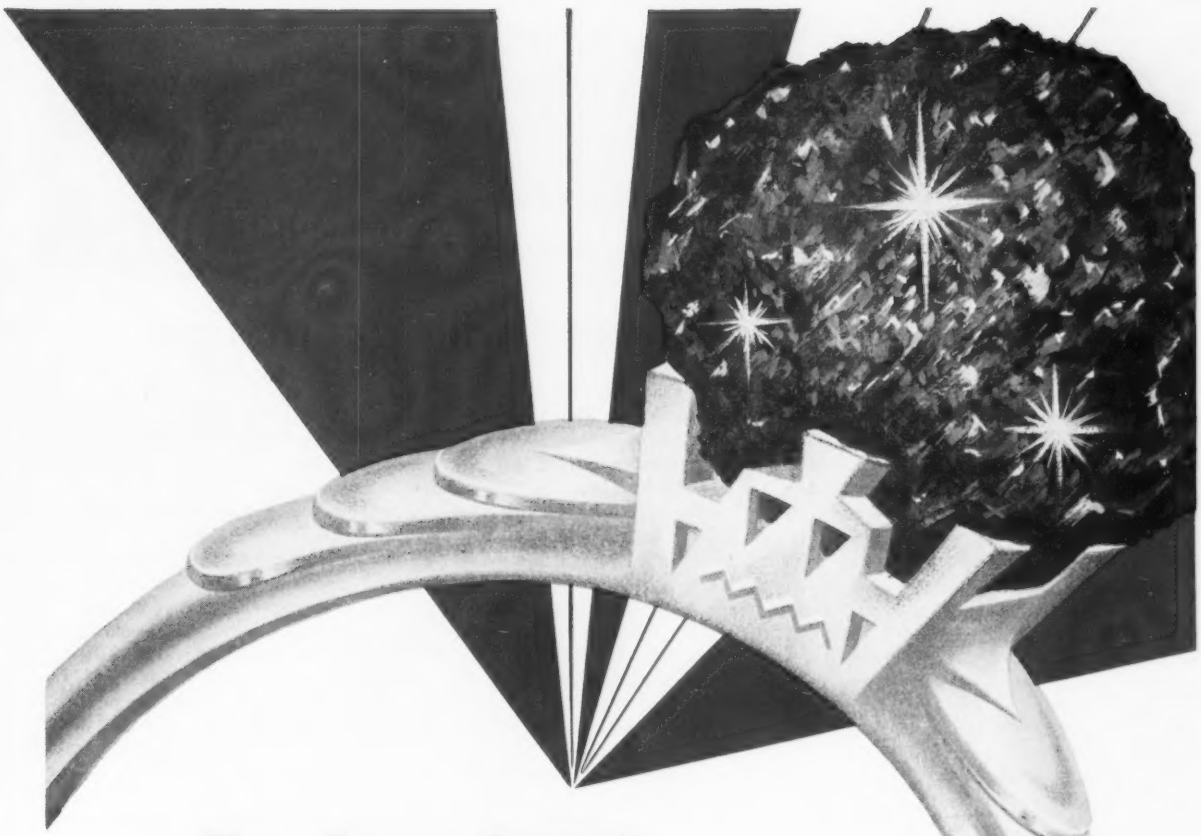
The government of the Argentine province of Cordoba has seized an American & Foreign Power-owned electric power plant, in direct opposition to national policy. This is the first such move since the fall of Peron.

Automation has made its initial attack on the Tuesday Afternoon Bridge Club. One of these days when a fourth for cards is needed the host may wheel a hulking digital computer into the living room. Burroughs has a machine that plays a snappy game of blackjack now. Bridge is next.

London (McGraw-Hill World News) Britain has officially decided to triple its atomic output by 1965. Increased capacity will involve a total expenditure of between 2.8 and 3.1-billion dollars. A year's such operation would save 18-million tons of coal.

Guarded support for the recent tri-partite agreement, reached by this country, Britain and Canada, on declassification of restricted data on atomic energy has come from the Chamber of Commerce of the U.S. Spokesmen expressed hope that removal of secrecy will benefit educators.

108-mile pipeline which will carry coal from mine to plant is ready for tests, say spokesmen for the Hanna Coal Co. Pumping of test water has been delayed by an initial plug, now cleared away. Cause of stoppage—an improper size mixture. Workmen are keeping their fingers crossed.



Precious Jewel of Industry's Future

"Black Diamonds" are America's most valuable resource for today and tomorrow! Only Bituminous coal can fully meet industry's needs for more electrical energy and more plant-power.

Convenient reserves of B&O Bituminous offer an unlimited supply of coals for every purpose, at low-cost. *Ask our man!*

LET OUR COAL TRAFFIC REPRESENTATIVES suggest a B&O Bituminous for your needs.

COAL TRAFFIC DEPARTMENT B&O RAILROAD
Baltimore 1, Md. LExington 9-0400

BALTIMORE & OHIO RAILROAD

Bituminous Coals For Every Purpose

LINKING 13 GREAT STATES WITH THE NATION B&O ®

TECHNICAL BRIEFS

Latest engineering developments for busy power men

26 papers for you on
CORROSION
MATERIALS
HEAT TRANSFER
ELECTRICITY

Flue gas makeup affects boiler corrosion

Low-temperature deposits and corrosion in boilers. *By J R Jenkinson, Green Fuel Economizer Co, Inc.*

This paper describes the behavior of flue gas constituents that form deposits and cause corrosion of metallic surfaces. Sulfatic and phosphatic deposits are discussed.

The condensation of sulfatic acid in the flue gases on metallic surfaces, and in the gas stream itself, the acid dewpoint and concentration of acid below the dewpoint, sulfurous acid, hydrochloric acid, and the influence of iron salts on corrosion are all surveyed.

The final part of the paper deals with the modern process of on-load washing economizers and air heaters to obtain maximum availability, minimize corrosion and reduce gas exit temperatures in spite of the present trend in fuel deterioration. *ASME paper No. 56-A-184.*

The formation of sulfuric acid in boiler flue gases. *By W F Harlow, International Combustion Products, Ltd.*

The present work confirms the previously recorded conclusions that formation of the sulfuric acid that affects boiler plant operation is a surface effect. It occurs mainly on the heating tubes, particularly the superheater. That formed in the combustion process, if any, is unimportant. Some formation can take place on furnace walls but in boilers with large combustion chambers this is small compared with that formed elsewhere.

The effect can be controlled and prevented for considerable periods by surface treatment of the tubes, both metallurgical and chemical. Therefore, acid formation is not an inherent feature of the combustion process, nor is its prevention an insuperable problem.

The author believes that more progress could be made in avoiding boiler deposits and corrosion by preventing the acid formation than by dealing with its effects. This would also obviate a serious source of atmospheric pollution. *ASME paper No. 56-A-159.*

Directions for ordering papers on page 222

Use of the Bureau of Mines condensate-corrosion tester for the survey of return-line deterioration. *By A A Berk, U.S. Dept of the Interior.*

The Bureau of Mines condensate-corrosion tester was developed to determine the plants in which preventive treatment was economically desirable. More than a thousand testers have been distributed to federal heating and power plants, and about 400 had been returned for evaluation when this paper was written.

The findings show clearly that most plants have no condensate-corrosion problem, probably because the plants are operated at relatively low pressure and very little makeup. The largest single factor causing return-line deterioration was a high carbonic acid content in the condensate caused by a high percentage of boiler-feedwater makeup. Similarly, soda-ash treatment of the feedwater caused many of the corrosion problems disclosed.

Chemical treatment with neutralizing amines proved to be very dependable, as determined by the tester survey. Filming treatments were consistently much less effective; however, very little is known about the distribution of such chemicals in relation to water quality, and no explanation can now be advanced for the relatively poor results.

The Bureau tester is a composite nipple and, as such, shows a corrosion pattern as well as an average loss of weight that may be translated into a corrosion index. It has been possible to correlate tester results with maintenance costs available at a defense agency, and the parallelism is good. *ASME paper No. 56-A-179.*

Materials

Austenitic steels in high-temperature steam piping. *By R M Curran and A W Rankin, General Electric Co.*

The austenitic steels are required for further advances in throttle temperature, and even these must ultimately be supplanted by the superalloys if continuous progress in power generation by increasing throttle temperatures is desired. Metallurgy's difficult role in introducing the highly alloyed austenitic steels concomitant with the long life required for generation equipment is difficult to underestimate. But significant progress has been made.

The developments now available in welding procedures, electrode compositions, and postweld treatments have already resulted in major improvements in austenitic weldment reliability. Difficulties encountered with the austenitic piping materials can be greatly minimized by: (1) Avoiding notches or sharp changes in section, especially in the vicinity of welded joints. (2) Ensuring that piping systems move in accordance with design to prevent excessively high bending stresses. (3) Providing a proper postweld heat treatment of all welded joints.

Still further improvements in fabrication and operating reliability will be available if the early results on developments like the 16-8-2 electrode and the hot ductility test bear out their promises. *ASME paper No. 56-A-217.*

Effects of neutron radiation upon the tensile and impact properties of ASTM-A302-B steel. *By E E Baldwin, General Electric Co.*

With the use of high-yield strength low-alloy steels for nuclear reactor pressure vessels, it is important to know whether the operating conditions of temperature and radiation will affect the mechanical properties of these steels and the magnitude of such effects.

Tensile and impact specimens of ASTM-A302-51T Grade B manganese-molybdenum steel were fabricated, canned, charged into the Brookhaven reactor, and irradiated to a calculated integrated fast-neutron flux of 3.7 x 10^{18} nvt at 500 and 700 F.

Comparison of tensile and impact-test data on irradiated and unirradiated specimens showed that the separate and combined effects of temperature and radiation had only minor effects (less than 10%) upon the tensile and impact properties of the steel tested. *ASME paper No. 56-A-107.*

More Technical Briefs on page 164

Which packing
for longer life in reciprocating service?

To 500F it's J-M Interlocked

because it cannot ravel or come apart

Made by an exclusive J-M process, Interlocked packing is braided from tough long-fibre asbestos yarns strongly interlocked in a solid integral structure. There are no jackets to wear through . . . no plaits to loosen. That's why it retains its strength and efficiency far longer than other types.

Interlocked also seals better. It is flexible and resilient, braided square for better contact and requires less gland pressure. Style 255 is effective against steam, hot or cold water, oil, weak acids and caustics. Furnished lubricated and graphited in ring and coil forms in sizes from ¼" and up.

To 750F it's J-M Superheat

because it does not harden under high heat

Designed specifically for superheated steam between 500F and 750F, Johns-Manville's Superheat packing is made of highest quality pure asbestos cloth which retains its resiliency even after long exposure to high temperatures. Woven tight, spiral wrapped and then pressed square, this cloth forms a firm resilient structure of superior strength and wearability.

Style 167 Superheat is bonded with a special heat resistant compound. No excess is present to carbonize in use. Density is carefully controlled for minimum gland pressure. Furnished graphited in ring and coil forms in sizes from ¼" and up.

Your local J-M distributor carries full stocks of Interlocked and Superheat and other packings. Call him today or write Johns-Manville, Box **14,** New York 16, N. Y. In Canada, Port Credit, Ontario.

Johns-Manville PACKINGS, GASKETS and TEXTILES

More TECHNICAL BRIEFS

Begins on page 162

Practical solution of plastic deformation problems in the elastic-plastic range. *By A Mendelson and S S Manson, Lewis Flight Propulsion Laboratory.*

A practical method for solving plastic-deformation problems in the elastic-plastic range is presented. The method is one of successive approximations and is illustrated by four examples which include a flat plate with temperature distribution across the width, a thin shell with axial temperature distribution, a solid cylinder with radial temperature distribution, and a rotating disk with radial temperature distribution. *ASME paper No. 56-A-202.*

Heat transfer

Heat transfer by radiation from flames. *By R A Sherman, Battelle Memorial Institute.*

Paper presents a summary of the work of the International Flame Research Foundation. The research is being conducted at the Royal Netherlands Blast Furnace and Steel Works.

This paper outlines the organization of the work, the experimental facilities, the methods of research, and presents the outstanding results on the effect of the variables studied on flame radiation.

These variables have been the type of fuel oils or coke-oven gas, the rate of heat input, type and rate of supply of atomizing agent, type of burner, excess of air, type and amount of carbureting agent for gas, and the temperature of the combustion air. Of these several variables, the C/H ratio of the oil and gas fuels and the mixing conditions most markedly affect the emissivity and the radiation of the flames. The results point to the need for further knowledge of the relation of the radiating characteristics of flames to the rate of heat transfer to "work" in furnaces. The research has now been extended to include the use of pulverized coal. *ASME paper No. 56-A-111.*

A theoretical analysis of heat transfer in natural convection and in boiling. *By Y P Chang, Taiwan College of Engineering.*

A theoretical analysis of natural convection and of boiling heat transfer is presented. Instead of approaching these problems according to a conventional concept, a short-cut method is introduced by the application of wave motion. Above the heating surface a boundary layer is assumed whose thickness depends on the heat flow. Inside this layer there is wave motion, stable in the lower part but unstable in the upper.

It has been recognized that, if there is a temperature gradient across a stratum of liquid, a wave motion will occur. Each loop of this wave can initiate vortexes in the natural-convection process and can also facilitate the formation of bubbles in boiling. A unified formula is thus obtained for convection and for boiling.

The calculated results agree excellently with experiments as conducted by previous investigators. This paper shows how the concept of wave motion can be made of use in giving a new picture of these heat transfer processes. *ASME paper No. 56-A-42.*

Electricity

Detection of faults in power transformers. *By E A Klingshirn, Youngstown University, H R Moore and F C Wentz, Westinghouse Electric Corp.*

The purpose of this paper is to review and evaluate the available devices and schemes for fault detection in transformers. The relative sensitivity of differential and gas actuated relays is determined by studying their responses to a single turn-to-turn short circuit, a typical fault condition resulting in a relatively low fault current.

A method of predicting fault current and heating in a single short-circuited turn is developed to make it possible to determine relay performance on this basis. The final result is a comparison of response of various relays to a single turn short circuit in typical power transformers. *AIEE paper No. 57-21.*

Calculation of windage noise power level in large induction motors. *By M E Talaat, Elliott Co.*

The author has set forth a method by which the design engineer can predict, subject to the degree of accuracy of his measuring instruments, the noise power level generated by his machine in much the same manner as the electrical performance is now predicted. With the noise power level radiated by the machine known, and the location of the intended installation known, the engineer can predict the sound intensity level at any desired point in the noise field of the machine.

Methods of reducing the noise power level include (1) smoothing out the variations in the resistance to air flow (2) decreasing the pressure behind the variable air flow resistance (3) adjusting the frequency generated (changing the number of rotor slots). *AIEE paper No. CP 56-1010.*

Report on lightning arrester applications for stations and substations. *By AIEE working group of the Lightning Protective Devices Subcommittee of the AIEE Committee on Protective Devices.*

The protection of electrical equipment insulation from damage by lightning is of utmost importance in power system operation. Equipment failures due to lightning cause service interruptions and increased operating costs.

The objective of this report is to state what is accepted as good practice in the application of valve type lightning arresters for protecting electrical equipment in stations and substations.

The report includes information on application of valve type arresters (1) at stations and substations operating from 23 through 330 kv to protect oil-filled equipment (2) at metal clad and metal enclosed switchgear installations operating from 2.3 kv through 34.5 kv, in which cable is terminated (3) at stations and substations where rotating machines are installed.

The application of expulsion type arresters is not covered. *AIEE paper No. CP 57-22.*

Resources

The coal and lignite situation in Japan. *By Yoshihiro Yatagai, and Shinzo Fuhta.*

This paper aims at summarizing the quantity and quality of coal reserves, the production and consumption of coal, the progress of coal mining techniques and methods, and the condition of the lignite industry in Japan. *WPC paper No.34A6.*

Sweden's fuel resources and their utilization for power production. *By Erik Blomqvist, and Folke Petri.*

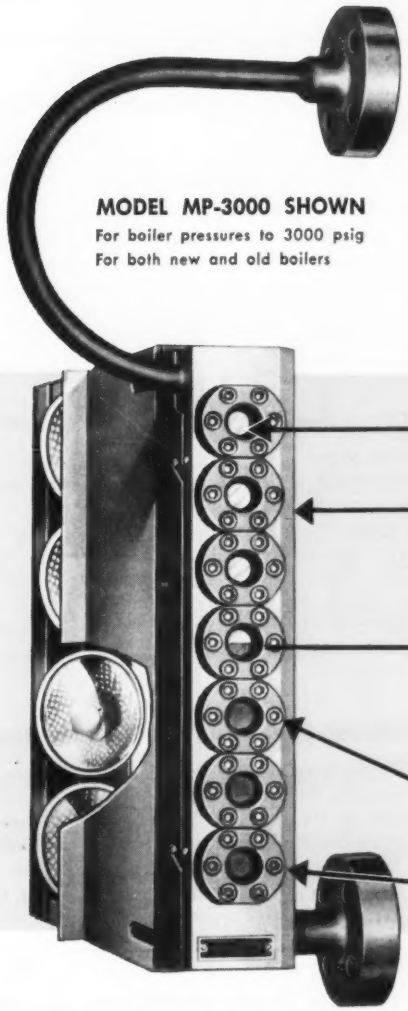
In Sweden, the demand for fuel is met during peacetime mainly by import. Among the native fuels, wood occupies a dominant position, but its role as a fuel source is gradually decreasing. Forestry products are finding more valuable use in other fields, through industrial manufacturing processes. Pit coal resources are small, but those of

(*Continued on page* 212)

Directions for ordering papers on page 222

MORE THAN ~~950~~ 1400 DIAMOND MULTI-PORT GAUGES

In use and on order for over ~~240~~ 300 Central Station Generating Plants



MODEL MP-3000 SHOWN
For boiler pressures to 3000 psig
For both new and old boilers

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS

GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE

STEAM SHOWS RED
WATER SHOWS GREEN

Also available is Model MP-900 for boiler pressures to 900 psig

COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES

EACH PORT THERMALLY INDEPENDENT

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 1400 for central station generating plants, more than 150 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

Write for Bulletin 1174U (Model MP-3000) or Bulletin 2044U (Model MP-900) for more information.

7801

Diamond

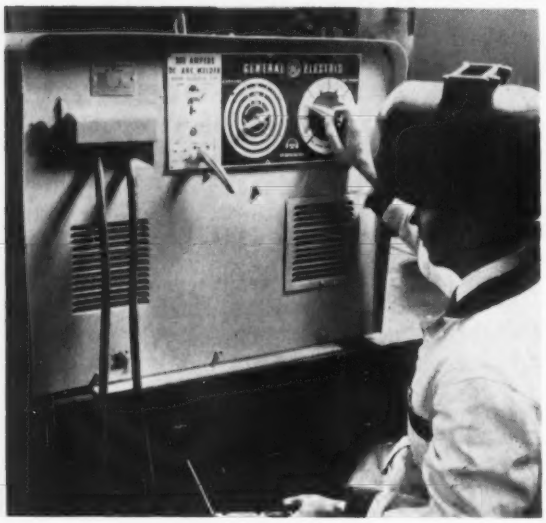
DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED — *Windsor, Ontario*

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



Motor-generator welders can be stacked

501 • Line of motor-generator welders features pre-lubricated, sealed bearings, controlled current peaks and space saving design, according to the manufacturer.

Its designers emphasize that, due to compact, sturdy construction, the welders may be stacked—one atop the other—thus reducing the amount of floor space needed.

Units, designated *WD30AE* and *WD40AE*, may, according to manufacturer, be used for virtually all industrial uses, including light-to-heavy dc metal and inert arc welding.

General Electric Company, Schenectady 5, N. Y.

Oil filter has throw-away cartridge

502 • Series of oil filters features a throwaway cartridge and easy service of the simplified three-piece construction.

Units are specially designed for the filtration of lubricating and fuel oils used in internal-combustion engines, for oil bath air filters and for the filtration of various types of industrial oils, fuel oils, solvents, coolants used in the manufacturing and chemical process industries. Request further details from manufacturer.

The Hilliard Corporation, Elmira, N. Y.

Oil system monitors own operation

503 • Circulating oil system is designed to serve the needs of presses, automatic and semi-automatic machine tools, according to the manufacturer.

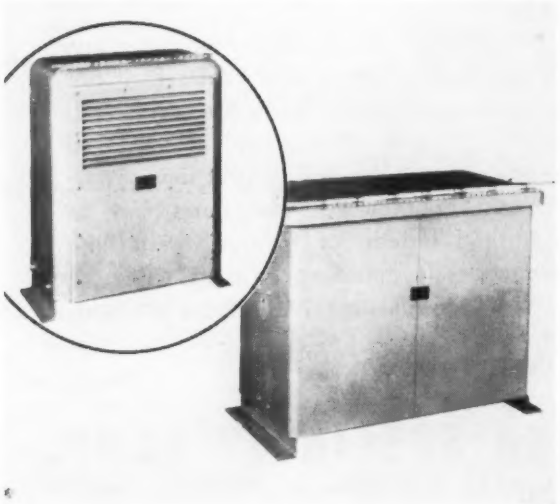
Unit monitors its own operation through a pressure-sensing mechanism to warn of clogged or broken lines in any part of the system. For operating flexibility, a variable-delivery pumping unit permits a wide range in the number of injections a minute to bearing points.

Farval Corp, 3249 E 80th St, Cleveland 4, Ohio

Lubricant has strong affinity for metal

504 • Molybdenum disulfide lubricant has a strong affinity for bonding to metal without building excessive accumulation on the surface. A decrease in particle size brings more molybdenum disulfide in contact with the metal; less solid content reduces surface accumulation.

Alpha Molykote Corp, 65 Harvard Ave, Stamford, Conn.



Transformer shows weight and size loss

505 • Dry-type three-phase distribution transformer features reduced weight and size; is said to be quietier and have an improved appearance.

Unit uses inorganic insulation, basically silicone, and is designed for 150 C temperature rise. Overall volume is said to be 25 to 51% less than Class B, 80 C design. Weight reductions range from 17 to 32%.

Sound levels in the new transformer are said to be substantially lower than in previous designs. Mechanically-isolated core and coils reduce transmission of noise, permitting connection of right conduit to the case without causing noise transmission throughout the conduit and mounting equipment. Three-phase units in 600 or 2400-v class come in ratings from 45 to 300 kva.

Westinghouse Electric Corp,
Box 2099, Pittsburgh 30, Pa.

For additional information on these new equipment items, use post cards on p 175. Identify your request with item number.

Crane Valves Prove Their Value on Steam Service

Out-slugs steam for 34 years!

Valve records like this can point the way to lower piping maintenance costs in your own plant!

Here you see a Crane 175-pound Ferrosteel gate valve with 34 cost-free years on 80 psi. steam service—one of a 40-valve installation made in 1923 at Long-Bell Division of International Paper Company, at Longview, Wash.

In all that time, only one of the original 40 valves has been replaced. More important, 39 of the original valves . . . and the replacement . . . are still giving dependable control of steam to kilns—with no more than routine stuffing box maintenance since installation in 1923.

Be sure *your* operation gets low-cost valve service: insist on Crane valves and fittings, from the big, complete Crane line —first choice of industry for over a century.

ASK FOR your copy of "Valve Performance Facts" —32 case histories on valve installations throughout industry. See your Crane Representative or write Crane Co. today.

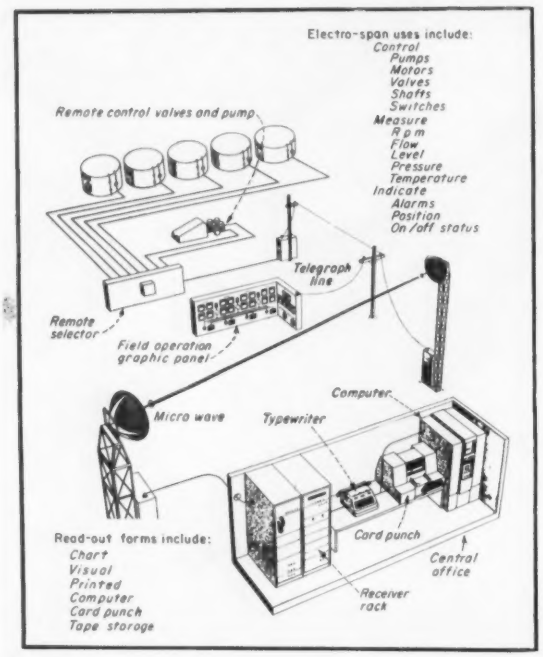
CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 166



Remote-control system relieves castaways

506 • Remote-control system of telemetering permits push-button operation of complex industrial processes going on hundreds of miles away.

Manufacturer points out that this eliminates the need for castaway maintenance men in isolated areas.

Manufacturer emphasizes that unit can operate over existing communication facilities, such as telephone and telegraph lines, and VHF and microwave radio bands. It operates on the digital computing system, measuring or sensing in terms of numbers.

System operates through the reception and transmission of automatically coded questions, reports and commands over circuits connecting the control point with the remote installation. The coded commands are translated into action, such as the automatic positioning of shafts, off-or-on switching of motors, pumps and valves, or measurement of temperature, pressure or other variables.

Diagram, at left, shows how unit is used to control industrial processes hundreds of miles away. In this case, electronic signals, transmitted by radio and telegraph lines, check liquid level in oil storage tanks, then turn valves and start pumps to feed correct amount into pipeline while computers automatically record and check what's going on. System is available in two types. Request details.

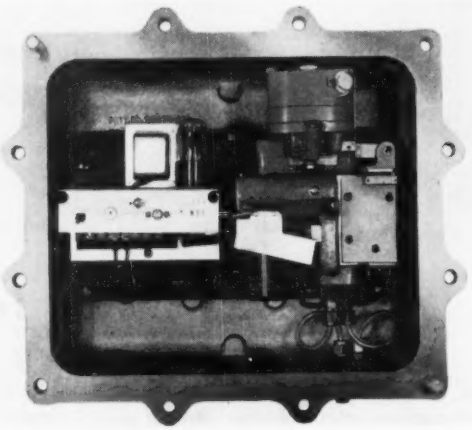
Bendix Aviation Corp, Fisher Bldg, Detroit, Mich.

Flexible shafts control valves

507 • Line of flexible shaft controls is suited for remote control of valves. Core of these shafts is made of multiple layers of precision wound high carbon wire. Casing is interlocked metal packed and is available in either galvanized steel or phosphor bronze.

According to manufacturer, this shafting with its variety of terminals makes possible the control of any type valve from almost any point in the plant. Plain valve couplings and quick disconnect attachments come in 3 types. These allow coupling to be disconnected quickly if it is necessary. Request details from manufacturer.

Stow Mfg Co, 443 State St, Binghamton, N. Y.



Level controller is explosion proof

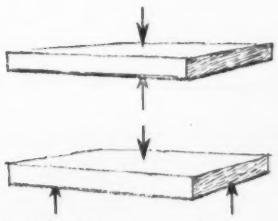
508 • Combination pneumatic-electronic controller is available in an explosion-proof model. Explosion-proof controller is intended for use in Class I, Group C and D and Class II, Group E, F and G hazardous locations.

Unit is capacitance-actuated and will convert the smallest change in level into a proportional air output. It is used to control the level of liquids. Installed with special probes, unit can also be used with granular solids.

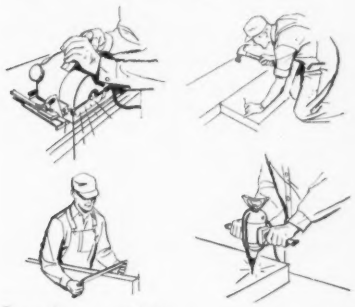
Probes are supplied in standard sizes and models.

Robertshaw-Fulton Controls Co
2920 N 4th St, Philadelphia 33, Pa.

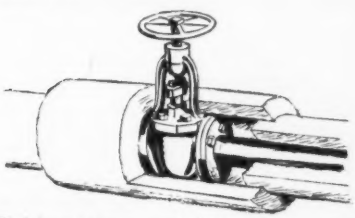
For more data on these items, use post cards on page 175. Identify your request with item number



Unequaled compressive and flexural strength!



Saw it . . . nail it . . . shave it . . . drill it!



Bridge joints and fittings without fear of breakage!

KAYLO® and FIBERGLAS*

INDUSTRIAL INSULATIONS

. . . distributed by approved Fiberglas distributor-contractors . . . offer the most versatile family of plant insulations available. With new *pink* Kaylo-*20* (increasing the upper range of Kaylo by 600° F.!), you can now order—from *one* reliable supplier—complete insulation coverage *from lowest sub-zero to 1800° F.*, serving such extra-high temperature applications as catalytic cracking units, refractory wall backing for furnaces and boilers, and fireproofing of piping, equipment, and vessel skirts. See *Sweet's Files*, *Chemical Engineering Catalog*, or *Refinery Catalog*. Or write Owens-Corning Fiberglas Corporation, Dept. 186-E, Toledo 1, Ohio.

OWENS-CORNING
FIBERGLAS

*T-M. (Reg. U.S. Pat. Off.) Owens-Corning Fiberglas Corporation
® T-M. Reg. Owens-Illinois Glass Co., Inc., mfr. of Kaylo

Specify

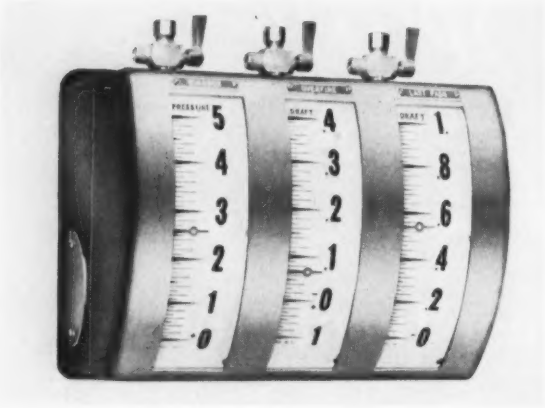
KAYLO®

Heat Insulation

for strength and lightness!

More EQUIPMENT NEWS

Begins on page 166



2 or 3-pointer draft gage saves space

509 • Dry-diaphragm vertical scale multi-pointer draft gages are suited for applications where easy readability and space saving are musts.

Units are available in 2-pointer or 3-pointer models which may be combined for multiple installations if desired. Units are used for measuring over-fire draft, outlet draft, first and last passes and windbox pressures. They are designed to be read from any point in boiler room with no parallax.

Scales are marked with designation desired by the customer by means of identification name plates.

Each instrument has a 3-way brass valve at the sample line inlet, which permits the operator to read the gage, to zero it and to shut it off. Complete details on request.

Cleveland Fuel Element Co,
111 Brookpark Rd, Cleveland, Ohio

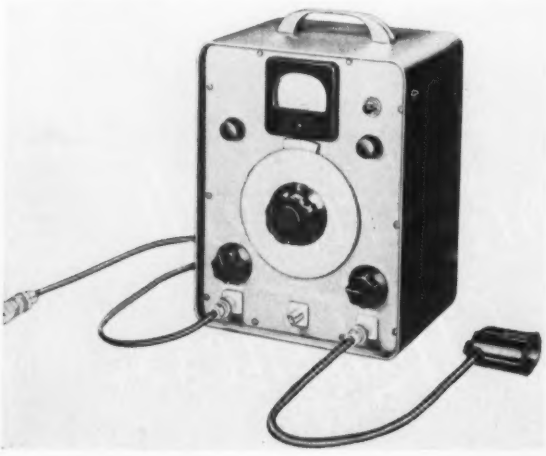
Digital flow totalizer for flowmeter use

510 • Digital flow totalizer is designed primarily for use with this company's flowmeters. Output from the turbine meter is continuously presented on a 7-digit register—a 5-digit mechanical counter plus a 2-digit electronic counter—showing total pulses, counts or cycles. The indicated count, multiplied by a constant, equals total flow in the desired units.

Accuracy of the totalizer is plus or minus one count. System accuracy, when totalizer is used with turbine water, is plus or minus 0.5% of indicated total. Counting rate ranges from 20 to 1000 cycles per second.

In addition to signals from turbine meters, unit can accept balanced 500 ohm inputs from any similar signal sources. Power requirements are nominally 50 watts (115 volts, 60 cycles). Controls permit manual reset of external reset and grating. Measurements of the unit are approximately 6x6x14 in. deep; weight is 15 lb. Request details from manufacturer.

Fischer & Porter Co, 952 Jasksonville Rd, Hatboro, Pa.



Indicator measures pressure change rate

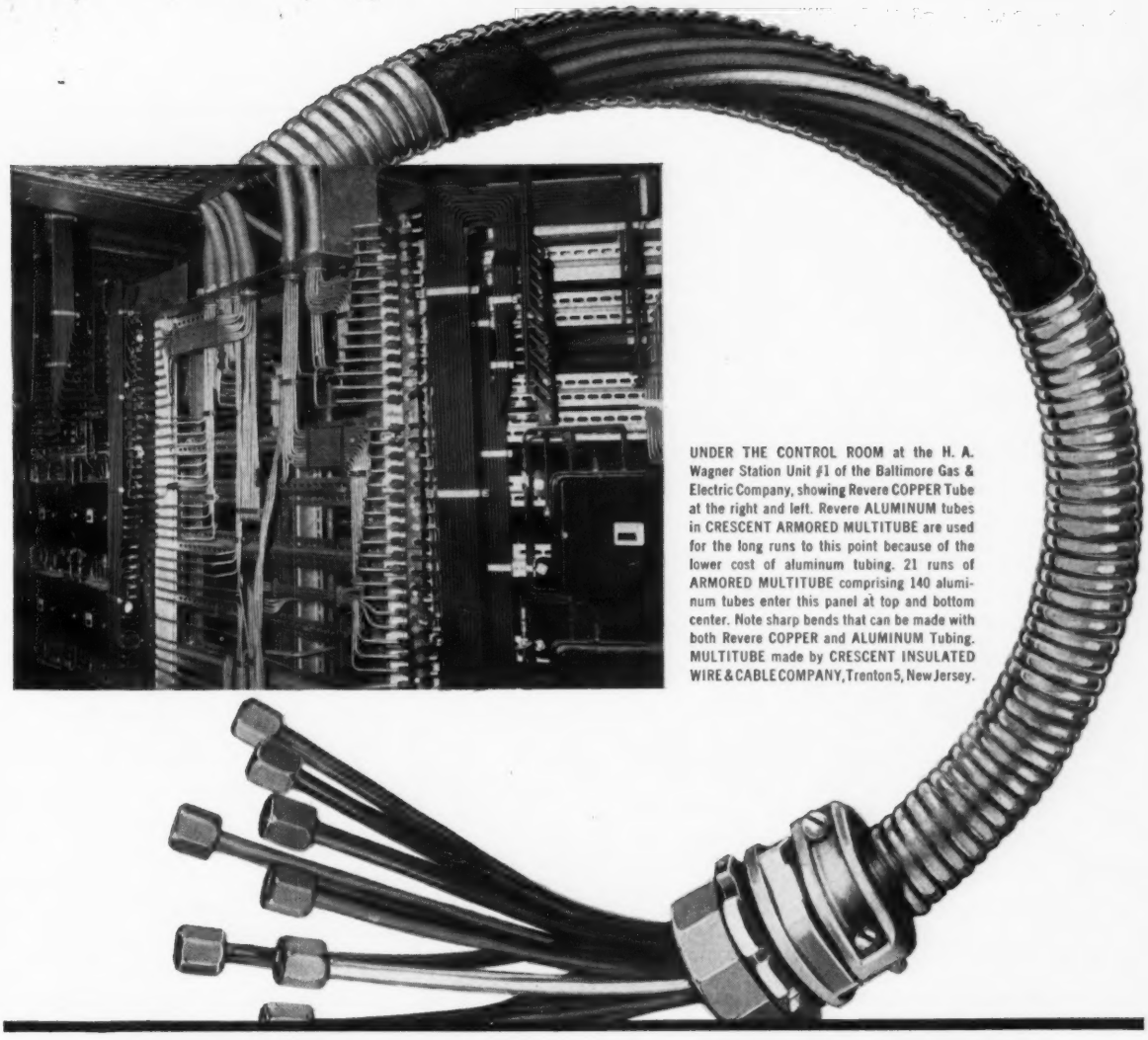
511 • Rate of pressure changes can be measured directly on this transducer system. According to manufacturer, instrument utilizes the electrostatic principle and permits precision rate of dynamic pressure measurements under the most severe conditions.

Through the use of an adaptor and resistor element, the electrical current generated in the quartz-crystal transducer is measured by an electrostatic type amplifier and displayed on a standard oscilloscope or recorder.

Instrument is described by manufacturer as extremely valuable for studying cylinder processes on engines and compressors. It is also said to be useful for indicating combustion and detonation phenomena in the evaluation of new engines and fuels. Other applications include shock tubes, gun tubes, rocket motors and hydraulic or pneumatic systems. Information and specs supplied in bulletin PI-114.

Kistler Instrument Corp, 15 Webster St, N Tonawanda, N.Y.

For more data on these items, use post cards on page 175. Identify your request with item number



UNDER THE CONTROL ROOM at the H. A. Wagner Station Unit #1 of the Baltimore Gas & Electric Company, showing Revere COPPER Tube at the right and left. Revere ALUMINUM tubes in CRESCENT ARMORED MULTITUBE are used for the long runs to this point because of the lower cost of aluminum tubing. 21 runs of ARMORED MULTITUBE comprising 140 aluminum tubes enter this panel at top and bottom center. Note sharp bends that can be made with both Revere COPPER and ALUMINUM Tubing. MULTITUBE made by CRESCENT INSULATED WIRE & CABLE COMPANY, Trenton 5, New Jersey.

CRESCENT relies on REVERE

for dependable performance of its instrumentation and control tubing

REPORTS, "NOT ONE FAILURE."

The dependable performance of Revere Copper Tube in Crescent Armored Multitube*, ever since its inception, has led the CRESCENT INSULATED WIRE & CABLE COMPANY to fill its aluminum tube needs with Revere also.

In fact, Crescent, since it first started using Revere Copper Tube in 1953, reports not a single failure. And that's mighty important in instrumentation and control tubing service where utilities, chemical processing, petroleum, paper and similar industries can't afford the luxury of process failures.

Crescent Multitube, using either Revere Copper or Aluminum Tube, or both in combination, offers a completely protected installation for permanence, lower original installation cost, lower maintenance and a saving of time, space and money.

Crescent Armored Multitube consists of a group of Revere Copper or Aluminum Tubes, twisted together in cable form, protected by a flexible interlocked galvanized steel armor. Constructions are available employing plastic sheaths in combination with the armor for corrosive locations. Section of cabled tube pictured shows how Copper or Aluminum Tubes are encased inside the Armored Multitube. As many as 37 tubes of ¼" OD can be cabled in lengths up to 1,000 ft.

For details on Multitube write Crescent and for uniform quality copper and aluminum tube, speedily delivered, see the nearest Revere Sales Office.

*Reg. Trademark

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

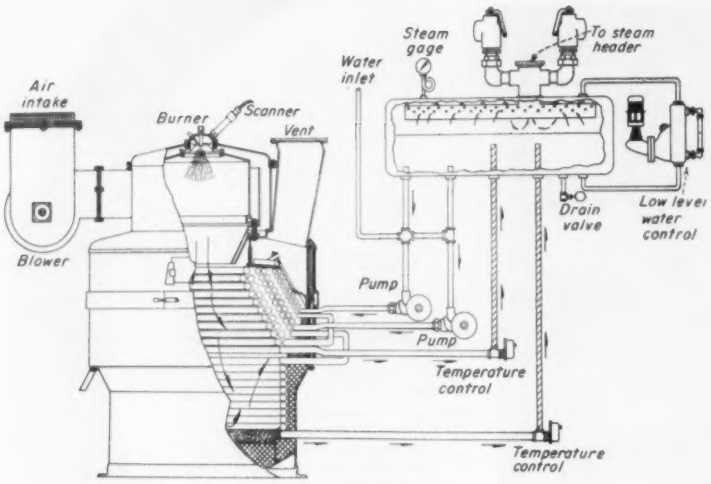
230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

COPPER • BRASS 18 01 • REVERE • ALUMINUM

More EQUIPMENT NEWS

Begins on page 166



Boiler heats plants with low-pressure steam

512 • Drum-type watertube heating boiler is designed to produce low-pressure steam, 5 to 15 lb pressure, for heating industrial plants and other commercial buildings. Other models of this 150-hp unit are designed to produce steam at up to 125 lb pressure.

Unit develops steam in five minutes from a cold start. Hot gases from an efficient forced draft fire, burning oil or city gas fuel, wipe over and around the four sets of steel coils heating the water as it is pumped through the coils. Steam rises off the water in the drum and passes through a specially designed separator inside the drum, to remove the excessive moisture, before the steam is fed into the plant's heating system.

Overall dimensions of the unit are: 96 in. high, 80 in. wide, 96 in. long, shipping weight 7400 lb—all mounted on a steel base plate. According to manufacturer, each unit will be completely assembled with automatic controls and thoroughly tested at the factory. Unit ships as a package.

Vapor Heating Corp, 6420 West Howard St, Chicago 31, Ill.

Large-capacity cooler

513 • Cooler offers a self-contained method of cooling and removing the moisture from compressed air, independent of a large supply of cooling water replacing both shell and tube cooler and cooling tower. According to manufacturer, it also provides, in one machine, provision for cooling compressed air and also for cooling water.

Niagara Blower Company
405 Lexington Ave, New York 17, N.Y.

Aluminum air mixers

514 • Dual duct air mixing units are made entirely of aluminum. Streams of hot and cold air are forced through a building in twin ducts and mixed in each room or office area to provide climates meeting individual requirements. Request additional details.

Buensod-Stacey, Inc
45 W 18th St, New York 11, N. Y.

Portable heater dryer

515 • Unit features three-way heat control—hot, cool and warm. Two models are available—both portable. Both feature a ball bearing brushless type motor that is self-cooling, a heavy-duty heating element. Request further details.

Ullman Products Corp
15 River St, Norwalk, Conn.

Vent separates air from water systems

516 • This unit is said to separate air from water systems for positive venting through a No. 75 or 78 vent valve. According to manufacturer, it assures top performance of a water system and reduces the noise caused by air.

It is also said that it can be located at any point in the system where air accumulates—at boiler or chiller, or at ends of mains.

Hoffman Specialty Mfg Co, 1700 W 10th St, Indianapolis 7, Ind.

Cyclone-type collector cuts plant dust

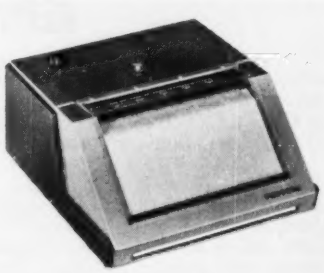
517 • Large volumes of bulky dust can be trapped from the air by this unit, says its manufacturer. Unit has recently been fitted with connections to standard 55-gal drums. Collector is intended for use with machinery that creates great quantities of dust.

Centrifugal force precipitates all but the very finest particles into the drum. Drums can be changed in 30 seconds, Request details.

Torit Mfg Co, Dept KP, 287 Walnut St, St. Paul 2, Minn.

In order to receive additional information on these new equipment items, use handy post cards provided on page 175. Identify your request with item number.

Be sure to check these items . . .



Potential transformer . . . . . p 180
Part-winding starter . . . . . p 182
Waterless aftercooler . . . . . p 184
Lightning arresters . . . . . p 188
Direct-writing oscillograph . . . . p 190
Vacuum tube voltmeter . . . . . p 190
Low ohmmeter . . . . . p 192
Valve actuators . . . . . p 196

Research-Cottrell 1956 Orders for 20 Central Station Precipitators

Consolidated Edison Company
STATION: ASTORIA • UNIT NUMBER: 3

Consolidated Edison Company
STATION: ARTHUR KILL • UNIT NUMBER: 2

New England Power Company
STATION: SALEM HARBOR • UNIT NUMBER: 3

A Prominent Southeastern Utility
2 PRECIPITATORS

Tampa Electric Company
STATION: GANNON • UNIT NUMBER: 2

Union Electric Company of Missouri
STATION: MERAMEC • UNIT NUMBER: 3

A Prominent New England Utility
1 PRECIPITATOR

New York State Electric and Gas Corporation
STATION: MILLIKEN • UNIT NUMBER: 2

Public Service Electric and Gas Company
STATION: BERGEN • UNIT NUMBER: 1 AND 2

The Hartford Electric Light Co.
STATION: MIDDLETOWN • UNIT NUMBER: 2

Virginia Electric and Power Company
STATION: CHESTERFIELD • UNIT NUMBER: 2

Delaware Power & Light Company
STATION: INDIAN RIVER • UNIT NUMBER: 2

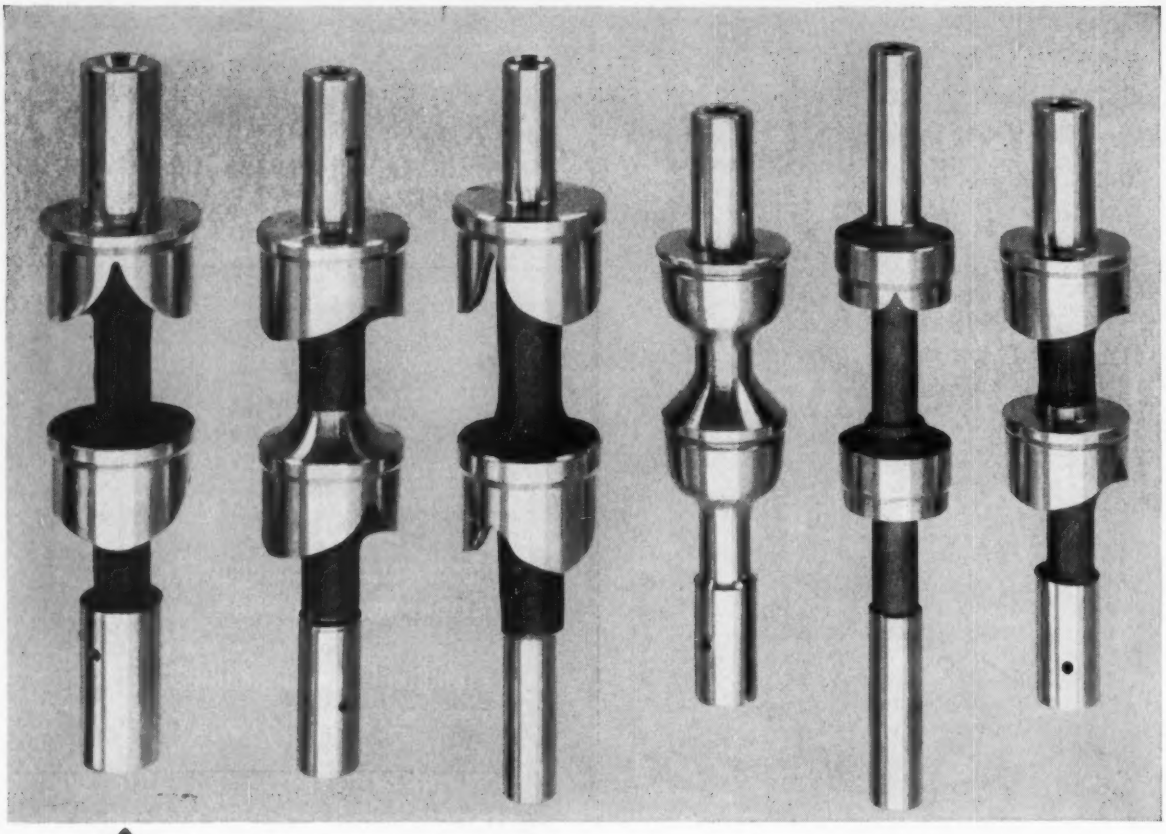
Commonwealth Edison Company
STATION: FISK • UNIT NUMBER: 19

The Detroit Edison Company
STATION: ST. CLAIR • UNIT NUMBER: 6

Research-Cottrell

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, New Jersey • 405 Lexington Ave., New York 17, N. Y.
Grant Building, Pittsburgh 19, Penna. • 228 No. La Salle St., Chicago 1, Ill. • 111 Sutter Bldg., San Francisco 4, Cal.

RC174



Inner secrets of inner valves

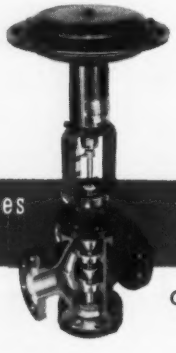
FACTS EVERY CONTROL VALVE USER SHOULD KNOW

This is a rare photograph . . . presented in a completely unretouched form. It shows the inner valve of leading makes of diaphragm control valves. The inner valve determines the control result.

The most amazing fact is the size . . . all are *listed* as two inch valves. All are high lift. But compare them.

Note the KIELEY & MUELLER inner valve at the far left. It equals the others on every point of consideration; exceeds on many. Look at the diameter across the skirt . . . that's one reason for the remarkable C_v of K&M valves. Look at skirt length; the solid, not fabricated, design. Measure the rugged guide posts and the large column. Examine the machining and the super-finishing.

It's no wonder . . . K&M is *the valve that likes to be compared.* It's a better valve and a better value by every measure of comparison.



FOR THE COMPLETE FACTS . . .
write for the K&M Valve Engineering Data Catalog, Bulletin CV53.

diaphragm control valves

K&M

Our 78th Year

KIELEY & MUELLER, INCORPORATED

Oldest Pressure and Level Control Valve Manufacturer

64 Genung Street, Middletown, New York

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

New free bulletins are listed and numbered, beginning on back of this page. To order those you want, write POWER item number here — *do not use manufacturer's bulletin number.* →

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your request to the various companies, they'll send the info

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before September 1, 1957. Void after this date. **5/57**

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power *a McGraw-Hill Publication*

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before September 1, 1957. Void after this date. **5/57**

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power *a McGraw-Hill Publication*

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before September 1, 1957. Void after this date. **5/57**

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power *a McGraw-Hill Publication*

This Month's FREE Literature

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

CONTROLS, ELECTRICAL & MECHANICAL

1 **Regulators** are subject of newly-revised 4-p bulletin 1044, rev 6. Includes revised size, capacity and weight tables. Meter & Valve Div, Rockwell Mfg Co, 400 N Lexington Ave, Pittsburgh 8, Pa.

2 **Automation system** is described in 8-p illustrated bulletin. Contains definitions, descriptions, block diagrams and photos. Research-Cottrell, Inc, Bound Brook, N. J.

3 **Electronic control centers** are subject of 8-p 5-color booklet F 8031. Discusses functions, uses and advantages of centralized automatic control. Special features are illustrated and described. Barber-Colman Co, 1400 Rock St, Rockford, Ill.

ELECTRICAL EQUIPMENT

4 **Electrical connections** are described in 6-p bulletin. Method of eliminating terminal lug difficulties is presented. Complete engineering information is given including informational methods for forming connections and data on special tool required. United States Research Corp, Bear Tavern Rd, Trenton 8, N. J.

5 Seven **publications** which comprise a Unit Substation Silver Anniversary **Technical Library** are: *Distribution Substations in System Planning* GER-1151; *Economical Size Substations for 12-kv Distribution*, GER-1299; *Converting a Radial to a Primary Network Distribution System*, GER-1313; *Master Unit Substations and Their Relay and Control Arrangements*, GET-2528; *Integrating Substation and System Planning Requirements to Reduce Over-all System Investment*, GET-2677; *Twenty-five Years of Progress in Unit Substations*, GEZ-1865; and *Use of Handbooks for Substation Planning Purposes*, GEZ-1867. General Electric Co, Schenectady 5, N. Y.

6 **Fluorescent lighting** is described in *Fluorescent Lighting Guide Book*. Illustrated 24-p booklet features sections on the general advantages, development of fluorescence, and includes chapters on each of lamp types, starters, lampholders, ballasts and special lamps. Sylvania Electric Products Inc, 60 Boston St, Salem, Mass.

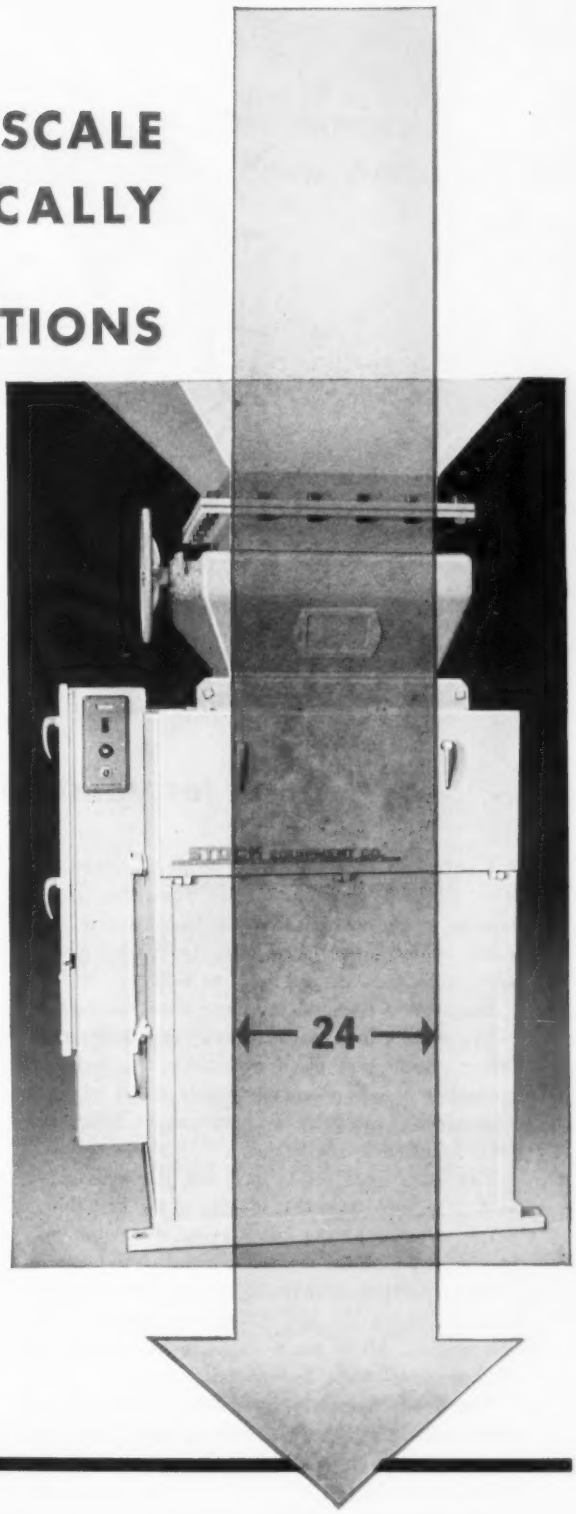
7 **Servo motor bulletin** offers engineers complete information on standard and custom servo motors. Data includes complete electrical and mechanical specs, application data on direct plate to plate, transistorized servo amplifier and magnetic servo amplifier applications. Illustrated 10-p bulletin 385 also offers characteristics and drawings. Norden-Ketay Corp, Commerce Rd, Stamford, Conn.

SAFETY EQUIPMENT AND MATERIALS

8 **Magnetic shielding** material is subject of 9-p bulletin 122. Describes advantages and methods of fabricating non-shock (*Continued on page* 206)

NEW S·E·CO. COAL SCALE DESIGNED SPECIFICALLY FOR LARGE CENTRAL STATIONS

Model 50 carries 24" wide stream of coal straight through without baffles, sloping skirts, or other restrictions



Modern push-button power plants burning large quantities of coal find it more desirable than ever to obtain accurate, up-to-the-minute coal weights. These weights help operators get the last BTU from each pound of coal by helping them determine boiler efficiency, keep inventory records and balance mills.

To provide these weights continually and without undue maintenance requirements, Stock Equipment Company engineers have developed the Model 50 Coal Scale. The inlet of this scale is a full 24" inside square. The extra wide feeder belt carries a stream 24" wide. The stainless steel weigh hopper has a 24" wide outlet. Because there are no restrictions or baffles inside the scale body, coal passes through easily, dependably, giving you the maximum in accuracy and trouble-free performance.

The Model 50 Coal Scale is only one of the ways in which Stock Equipment Company continues to meet the growing and changing needs of modern power plants. Years of experience in bunker to pulverizer and stoker equipment, combined with a constant attention to detail, make any S-E-Co. equipment the best you can buy for the job.

SPECIALISTS IN
BUNKER TO PULVERIZER AND
BUNKER TO STOKER EQUIPMENT

STOCK Equipment Company

745-P HANNA BLDG., CLEVELAND 15, OHIO

George Edwards

says, 'Don't let yourself be your own worst enemy'

► I RECEIVED a down-to-earth letter the other day from Roger Kimble out in San Francisco. Roger says he agrees with what I say from time to time about opportunities in industry for young fellows who didn't get a chance to go to college.

But he says I should say more about personality —how quirks in a guy's makeup can foul up his future. And point up, for instance, the fact that no matter how hard a man sweats it out at night school, if he can't get along with people, he'll never get to first base in any league.

The letter goes on to say that the personality angle is so important that it's one of the first things an employer wants to know about the fellow he's considering for a job.

Roger itemizes some traits, says anyone can check himself against the list. Listed are things a man *can* control. All he has to do is realize he's in one of these slots—then do something about it.

Any good supervisor, says Roger, quickly spots these traits in an otherwise capable man. And, just as quickly, will notice and help the guy who's trying to lick his trouble.

This is the way the letter puts it:

Intemperate. This fellow is likely to let the plant down just when he's needed most. He's kidding himself if he believes there's a substitute for reliability anywhere he may work.

Disloyal. Here we have a rotten apple in a barrel spoiling those around him. If a guy can't be loyal to his outfit, he should move to another job.

Emotionally unstable. Blows his stack under pressure. He's over-sensitive. Always imagines that the boss "has it in for him"—that he's not getting the breaks he should have.

Dishonest. This guy isn't a thief as we think of one. But he's a malicious gossip, maybe a little on the hypocrite side. He wastes others' time as well as his own. Added up, he's robbing his employer, his fellow workers, and himself.

Talks too much. He makes himself unpopular in a hurry. He means well but he just doesn't remember that his standard equipment is one mouth and two ears. Many times he talks himself out of a job without realizing it.

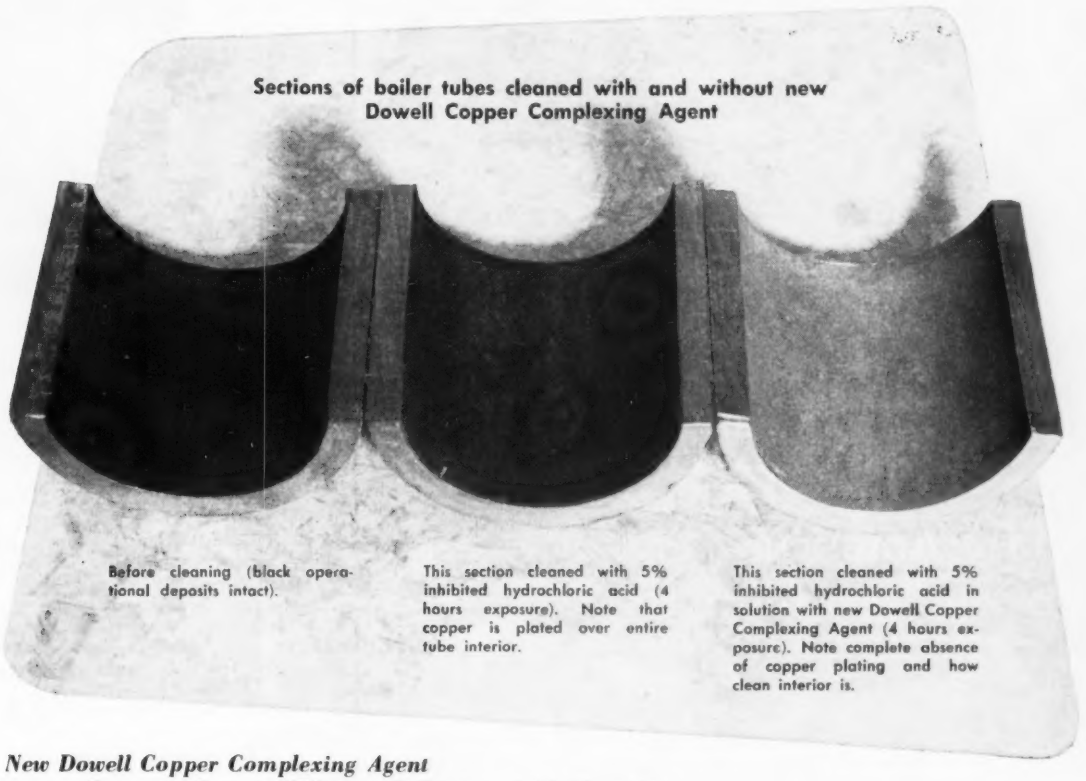
Poor disposition. Always has a chip on his shoulder. He's surly, arrogant and thinks he can get away with being a continual grouch. Sooner or later, he's marked for the skids.

Health. Every guy has aches and pains at times. This fellow, however, never "feels good." He stays home at the slightest excuse. It's tough on the men who have to carry his load and makes even the most sympathetic supervisor grit his teeth.

Roger winds up by saying that while this may sound harsh, it's a realistic picture of how management looks at these things.

He adds, "It's sometimes tough for a guy to swallow the truth about himself, but once he gets it down it can be the best medicine he's ever taken."

New single-stage chemical cleaning service removes copper, water-formed scale from boilers


Sections of boiler tubes cleaned with and without new Dowell Copper Complexing Agent
Before cleaning (black operational deposits intact).
This section cleaned with 5% inhibited hydrochloric acid (4 hours exposure). Note that copper is plated over entire tube interior.
This section cleaned with 5% inhibited hydrochloric acid in solution with new Dowell Copper Complexing Agent (4 hours exposure). Note complete absence of copper plating and how clean interior is.

New Dowell Copper Complexing Agent Prevents Copper "Plate-out" During Acid Cleaning

Dowell research has solved the problem of removing copper deposits, along with iron oxides and other water-formed deposits, in a *single-stage*, acid-fill boiler cleaning job. This single-stage chemical cleaning is made possible by a new copper-complexing agent*. When added to Dowell's regular cleaning solvents, this agent acts to dissolve copper deposits, and to complex copper ions so that they remain in solution in the spent acid and do not plate out on the newly cleaned metal.

Removal of copper from boiler tubes is of prime importance. Galvanic cells may be formed between the copper particles and exposed steel surfaces. Such cells may contribute to pitting during normal operation of the unit. Also copper deposits may interfere with heat transfer, leading to localized over-heating and sudden failure of the boiler tubes by rupture. Freshly plated copper may even slough and cause stoppage of the tubes.

Another distinct advantage of this new single-stage boiler cleaning service is in reduced boiler outage time. Boiler tubes can now be chemically cleaned—removing copper deposits in addition to water-formed scale and sludge in about one-half the time previously required to perform this service.

For complete information on how this new copper-complexing agent can help you, call the Dowell office near you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

*PATENTED

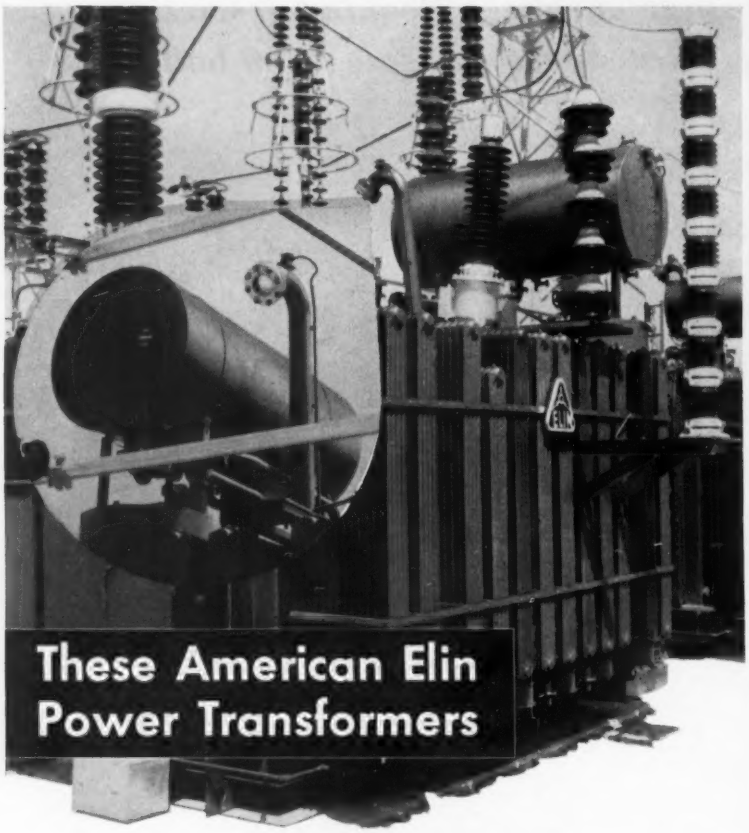
have Dowell clean it chemically

DOWELL

A SUBSIDIARY OF THE DOW CHEMICAL COMPANY

BS&B *Safety Heads*

Insure Protection For...



BS&B 6" Safety Heads are installed in gooseneck vents on power transformers manufactured by American Elin Corporation in their plant at Weiz, Austria. Some of these transformers are now in service at various U.S. Bureau of Reclamation Power Substations in the Middle West.

The reliability of BS&B Safety Heads was recently tested in practice by building up pressure on purpose when filling a transformer with oil. The rupture disc burst exactly at its rated bursting pressure of 12 psi.

Diaphragm rupture accuracy is an important safeguard against the danger of explosion in case of pressure-buildups, irrespective of their cause.

THE "CIRCUIT BREAKER" of Pressured Systems

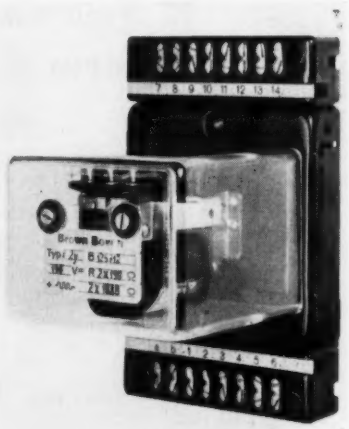
For information about how BS&B Safety Heads can be put to work for you, contact your nearest BS&B Representative or write to...

BLACK, SIVALLS & BRYSON, INC.

Safety Head Division
Dept. 2-Q5
7500 East 12th Street
Kansas City 26, Missouri

More EQUIPMENT NEWS

Begins on page 166



Dc contactor

527 • High-speed unit has a pick-up time of approximately 1/10 of a cycle. Known as type F, contactor's speed is rated at 1.8 milliseconds.

Type F contactor is a dc unit and comes either with 4 NO or NC contacts, or 2 NC and 2 NO contacts. Contacts have a sustained current rating of 5 amps; their making current is stated as 20 amps. Unit is designed for continuous duty and according to manufacturer, has a relatively small power consumption; continuous power is 4 w; max inrush power is 10 w.

Brown Boveri Corp,
19 Rector St, New York 6, N. Y.

Potential transformer

528 • High voltage unit is called the "cascade" because its winding arrangement is connected in series, or cascade. It is designed for line to ground connections on 115-kv circuit and above. Unit carries an ASA-rated 0.3 accuracy at standard burdens.

Unit is available in all standard ratings, 115 kv through 230 kv, and other designs can be made to customer specifications.

General Electric Co,
Schenectady 5, N. Y.

For more details on these items, use post cards p 175. Identify your request with item number.

Portable sump pump

522 • Self-contained portable sump pump has wide application in removal of sewage, sludge, chemicals, oil, and clean or dirty water from sumps, wells, etc.

Pump body, impeller and strainer are made of bronze, to resist corrosion and to insure spark-free operation. As a result, chemical solutions and inflammable or explosive liquids can be handled safely, according to manufacturer.

Pump speeds vary between 3200 and 3600 rpm, depending upon the head against

CHECK HIDDEN FEATURES of Allis-Chalmers Individually Enclosed

LOW VOLTAGE BREAKERS

Safe, Easy to Inspect . . . Simple, Easy to Mount

1. Easily accessible — Removal of deep front cover permits inspection and maintenance of breaker from front or sides.

2. Easy breaker removal — Pull-out construction permits removal without disconnecting cables. Cable connections are accessible through entire front opening.

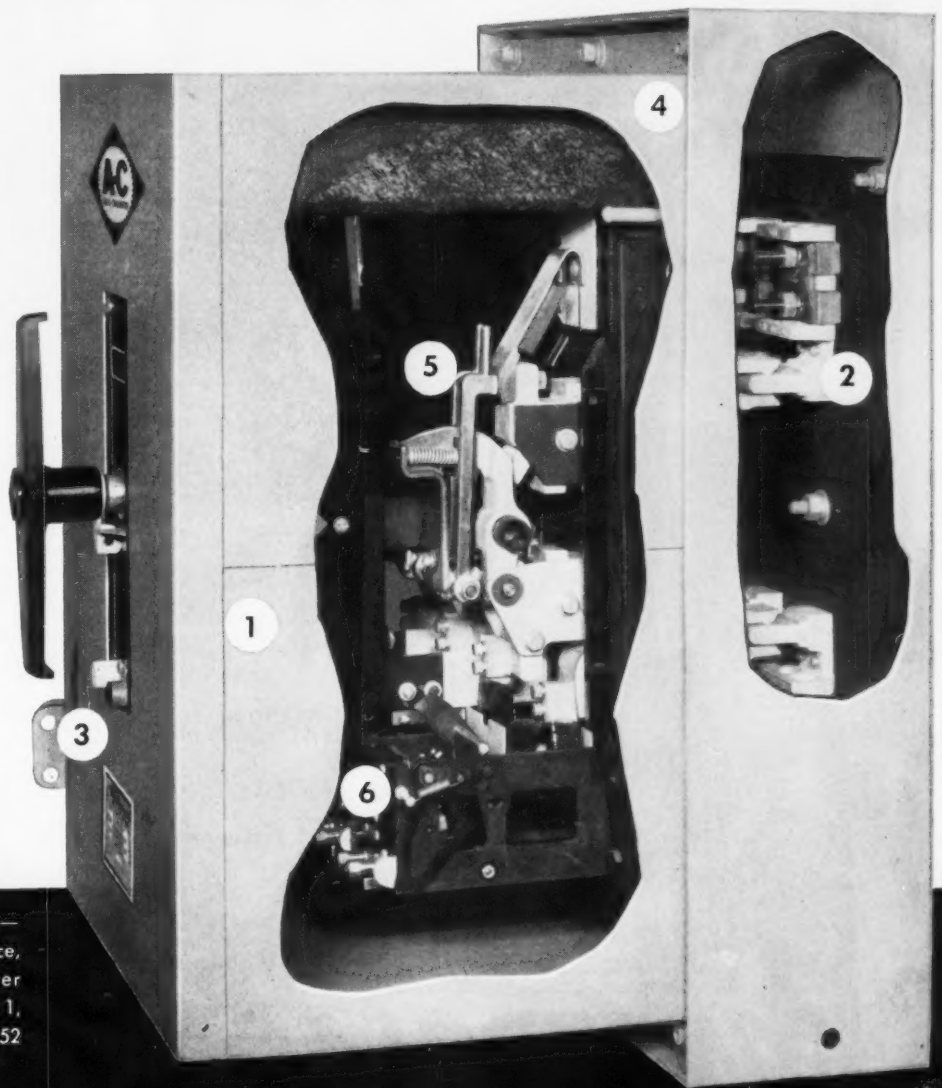
3. Safety Interlock — Prevents removal of cover while breaker contacts are closed.

4. Enclosures to meet your needs — Weather-proof or dust-proof as well as standard general purpose enclosures are available.

5. Long life contacts — There's no bounce—less erosion — due to high contact pressure with blow-on type action.

6. Accurate time-delay control — Hermetically sealed, positive displacement trip device is used.

For service to 600 volts ac, 1600 amperes continuous, 50,000 RMS amperes interrupting at 600 volts ac.



Get details, dimensions, prices — Contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletins 18B8252 and 18B8283.

PUBLIC BUILDINGS

INDUSTRIAL PLANTS

UTILITIES

ATHLETIC FIELDS

BUSINESS PLACES

THEATERS

ALLIS-CHALMERS

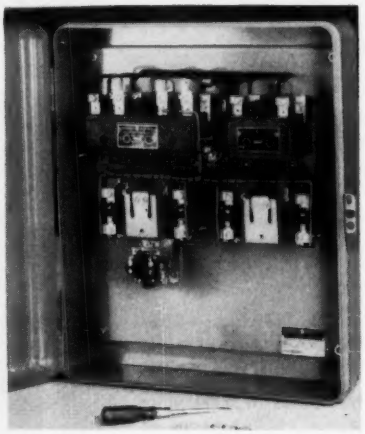
A-5220

More EQUIPMENT NEWS

Begins on page 166

which it is pumping and the supplied air pressure. Excessive speed is prevented by a built-in governor.

Schram, Inc,
900 E Virginia Ave, West Chester, Pa.



Part-winding starter

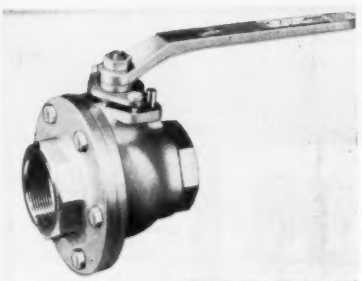
526 • Method of one-step increment starting for induction motors provides reduced light flicker and quieter motor operation during accelerations, according to manufacturer.

Major application of new starting method is expected to be in large commercial buildings and other locations where power companies require large induction motors be started with reduced KVA inrush. Typical uses are air conditioning compressors, refrigeration compressors, fans, pumps and blowers.

System will accelerate most loads to full speed on the part winding. This eliminates the second increment of current inrush characteristic of conventional part winding starting.

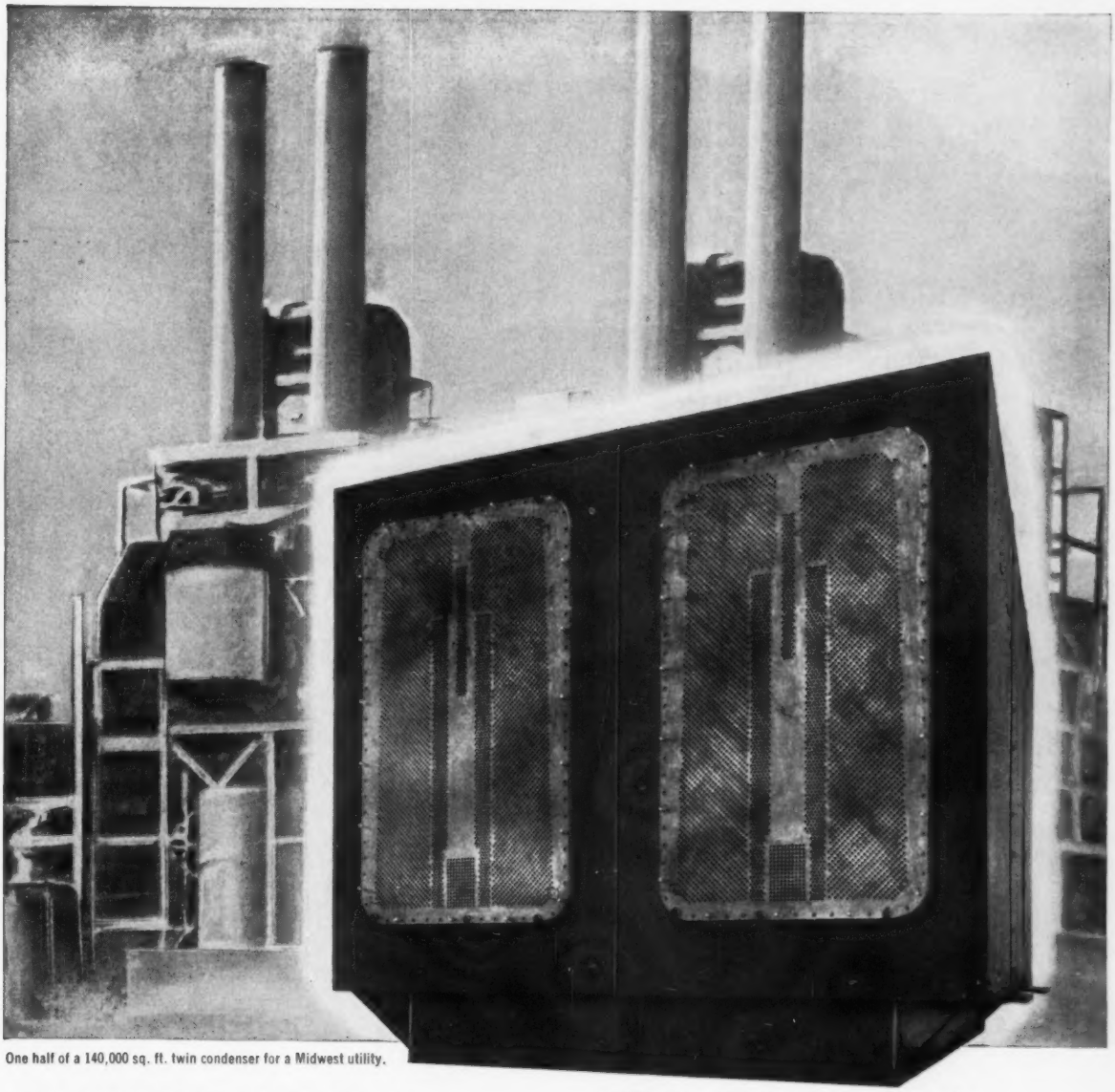
General Electric Co,
Schenectady 5, N. Y.

For more details on these items, use post cards p 175. Identify your request with item number.



Stainless steel ball valve

523 • Valve is equipped with Teflon seals and trim. Other types of seats are available upon request. Unit is said to have low pressure sealing and easy operation. Stem repacking can be done without re-



One half of a 140,000 sq. ft. twin condenser for a Midwest utility.

C. H. WHEELER Principles of Steam Condenser Design Win Approval of Large Utilities

To help modern power plants conserve every BTU of boiler fuel C. H. Wheeler is working constantly to design and build more efficient steam condensers. Here are just a few of the more important features in C. H. Wheeler Dual Bank Condensers that are recognized by large utilities:

- *Deaeration . . . 0.01 cc per liter is attainable.*
- *"Zero" condensate temperature depression.*
- *Purity of condensate.*
- *Additional steam lanes shorten path and resistance to steam travel.*
- *Lower pressure drop and higher vacuum.*
- *Specifically designed for larger, more efficient electric generating stations.*
- *Adaptable to any station layout and designed to minimize field erection problems.*

C. H. Wheeler representatives are located in principal cities. Let us present a proposal for the most modern Steam Condenser, Pumps and Auxiliaries for your electric generating plants of tomorrow.

WE703

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PA.

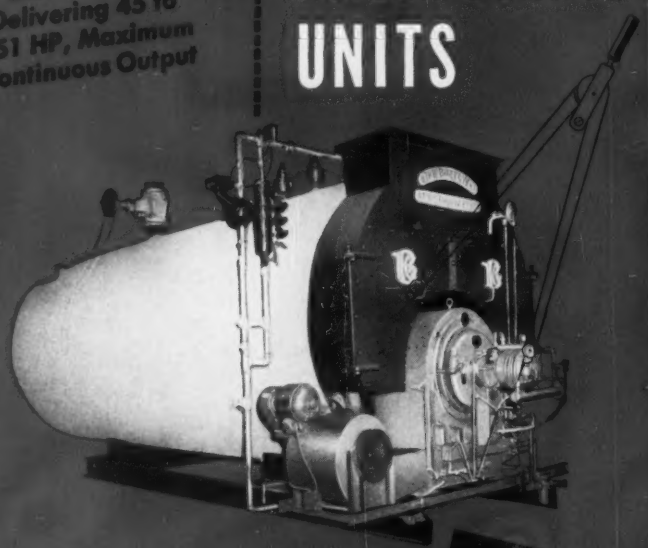
Steam Condensers • Vacuum Equipment • Pumps for Circulating Water, Condensate, Water Supply and Drainage • Marine Auxiliary Machinery • Special Products for Atomic Service

C.H. Wheeler OF PHILADELPHIA

Self-Contained Steam Production to Fit Your Need

19 SIZES
30 to 434 HP, S.B.I. Rating Delivering 45 to 651 HP, Maximum Continuous Output

BIGELOW
BOILER-BURNER
UNITS

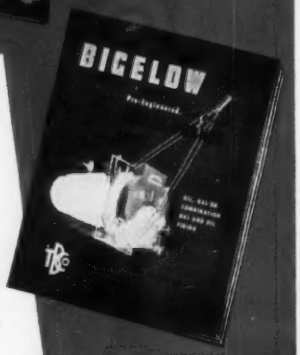


READY TO OPERATE AS SOON AS CONNECTED
Combines the boiler that closely fits your requirements with whatever top quality burner best suits your specific situation ... Mounted on a steel base ... Requires no special foundation, no high stack, no induced draft fan.

80% EFFICIENCY
Tubes correctly proportioned for efficient heat transfer promote 80% or greater efficiency.

RESERVE CAPACITY
8.2 square feet of heating surface per boiler horsepower, (STEEL BOILER INSTITUTE STANDARD) provides maximum continuous output reserve capacity 50% greater than nominal S.B.I. rating.

COMPLETELY AUTOMATIC — OIL, GAS OR COMBINATION GAS & OIL FIRING



Write For Your Copy Of This NEW BOILER-BURNER UNIT CATALOG

Catalogs also available on Bigelow Water Tube Boilers of various types.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.
Established 1899

Representatives: Boston • New York • Chicago • Orangeburg, S. C. • Philadelphia • Syracuse • Detroit • Washington, D. C. San Francisco • Los Angeles • Atlanta • Milwaukee • New Orleans Petersburg, Va. • Seattle • Indianapolis • Kansas City, Mo. • Tulsa Salisbury, Md. • Greensboro, N. C.

BI-17

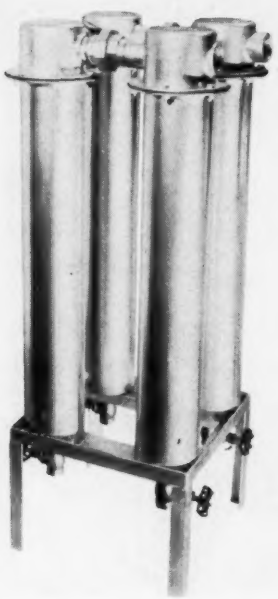
More EQUIPMENT NEWS

Begins on page 166

moving valve from line, according to manufacturer.

Unit handle can be put on in eight different positions. It is said to resist corrosion and last longer in service. Valve is available in ⅜ to 2-in. sizes.

Rockwood Sprinkler Co,
38 Harlow St, Worcester 5, Mass.



Waterless aftercooler

535 • Unit removes oil and water from compressed air lines. In addition to removing oil from lines, filters condense the water vapor present into entrained moisture and remove it from the lines.

According to manufacturer, their primary advantage is the elimination of the need for using water as a cooling agent. Units are made of 16 gage carbon steel sheet and are tested to 500 lbs internal pressure, which is considered adequate for ordinary air line installations.

Airlenco, Inc,
143 N Logan St, Elyria, Ohio

For more details on these items, use post cards p 175. Identify your request with item number.

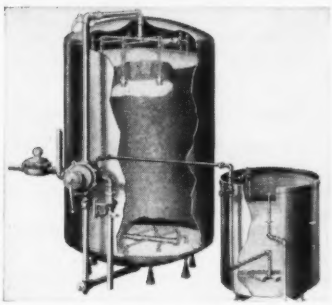
Feedwater regulator

536 • Unit, for high-duty steam generators, matches feedwater input to steam output, regardless of load conditions. It is also said to hold drum level within close limits, despite changes in load or feedwater pressure. Control is modulated by three influences — drum-water level, feedwater flow and steam flow.

System can be equipped with either diaphragm or piston operated control valves having rectangular, characteristic-V, sleeve or bevel-seated ports to match plant oper-

SOME GOOD ADVICE ABOUT WATER SOFTENER EQUIPMENT

Now we take off our kid gloves!



ELGIN "DOUBLE-CHECK" WATER SOFTENER

—greatest value ever

- **Up to 44% more soft water from a softener of given size.**
- **Prevents costly zeolite loss.**
- **Automatic or manual.**

3 to 10 times more soft water from your present softener

If your present water softener was quality-built and still has useful life, we can boost its soft water output 3 to 10 times by modernizing it to "Double-Check" design and refilling it with new high capacity zeolite. Let us have our nearest representative give you details.

ELGIN
WATER CONDITIONING
SINCE 1908

The man with the scowl (he might have been in charge of *your* plant) barked at an Elgin representative:

> "Why didn't you tell me I was throwing my money away when I fell for that cheap water softener?"

Our rep thought he had properly covered that delicate subject the day Elgin lost out to a lower bid . . . but now we know the warning must have been couched in too polite language. This being the case, we are now taking off our kid gloves and speaking out in no uncertain terms.

We speak, not just for Elgin, but for all reputable and established manufacturers in the water softening field, when we say: Fight shy of the Johnny-come-lately in the water softener business—the upstart who says in effect: "A water softener is just a collection of tanks and pipes and valves; anybody can make it; I can give you the same thing at a lower price."

The SAME thing? Your first shock will come the day the cheap softener is delivered when you discover the woeful lack of real quality construction. The next blow will be to find its performance is a bitter disappointment. The final blow will be to find as the months and years roll along that as the man with the scowl said: you have thrown your money away!

Harsh words? Yes, but true! Your own experience has shown you that in today's tough competition the SAME thing at a LOWER price just does not exist . . . and this is particularly true of water softeners. It takes the kind of experience Elgin has had to build the softener you see here. It takes the kind of knowledge Elgin has accumulated from a half-century of experience to correlate all the elements that contribute to efficiency and economy as you find them in Elgin conventional and "Double Check" Softeners.

For facts, write for literature...or, better still, let us put you in touch with your nearest Elgin representative.

ELGIN SOFTENER CORPORATION

130 North Grove Avenue • Elgin, Illinois

Representatives in Principal Cities • In Canada: G. F. Sterne & Sons, Brantford

ZEOLITE SOFTENERS • DEIONIZERS • DEALKALIZERS • CLARIFIERS • FILTERS • DEGASITORS • DEAERATING HEATERS • CHEMICALS

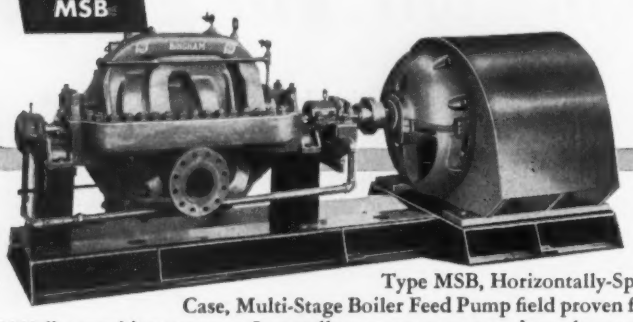
Specify

Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

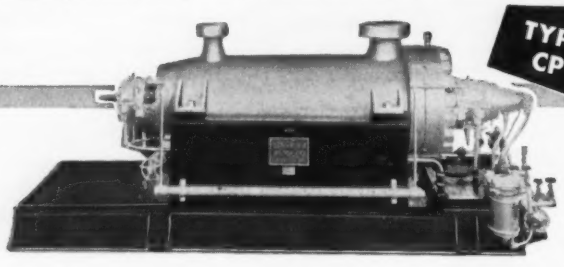
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: 2800 N. W. Front Ave., Portland 10, Oregon
Factories: Portland, Ore. • Vancouver, B. C., Canada

SALES AND SERVICE OFFICES

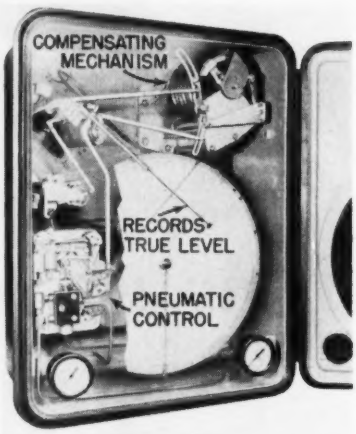
Boston, Mass.	New York City, N. Y.
Chicago, Ill.	Philadelphia, Pa.
Cleveland, Ohio	Pittsburgh, Pa.
Dallas, Texas	San Francisco, Calif.
Denver, Colo.	Seattle, Wash.
Houston, Texas	St. Louis, Mo.
Kansas City, Mo.	St. Paul, Minn.
Los Angeles, Calif.	Tulsa, Okla.
New Orleans, La.	Toronto, Ont., Can.
Vancouver, B. C., Canada	

More EQUIPMENT NEWS

Begins on page 166

ating conditions. Almost any desired opening or closing force can be provided, according to manufacturer. Ports are said to have flow areas exactly suited for specified flow and pressure conditions.

Copes-Vulcan Div, Blaw-Knox Co, 900 W 26th St, Erie, Pa.



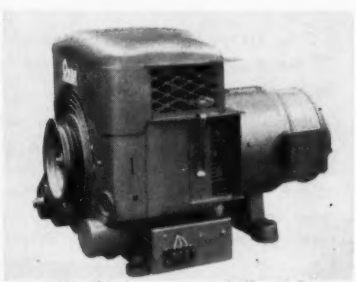
Compensating level recorder

534 • Automatic compensation of drum level measurements over entire boiler operating range is available in this instrument, according to manufacturer.

Bourdon helix compensator continuously readjusts the pen to record true drum level. Operating from drum pressure, the compensator offsets the effect of any change in specific weight of water. Thus, at saturation conditions, complete compensation is said to be achieved over entire ranges of level, pressure and temperature.

Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio

For more details on these items, use post cards p 175. Identify your request with item number.



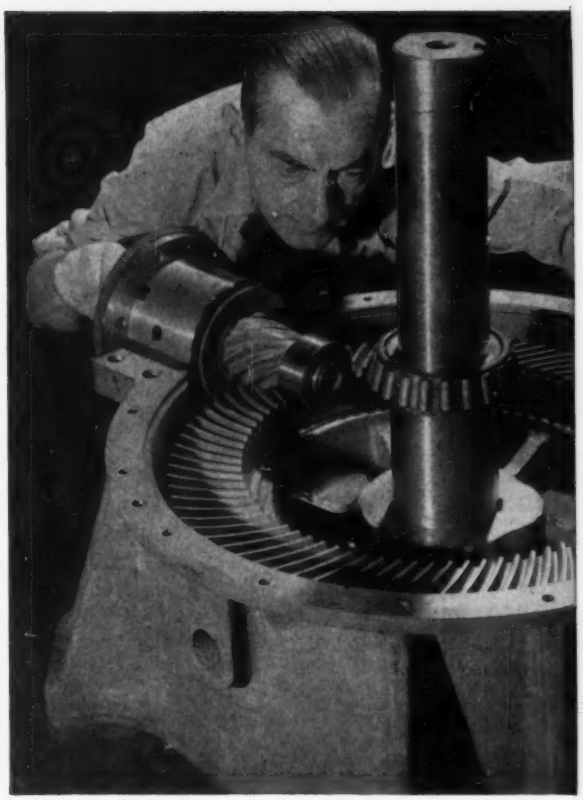
Magnet service electric plant

525 • Gasoline-engine-driven, 5000 watt electric plant is designed for magnet service. Compact and light in weight for its capacity (290 lb), this 5-kw generating set is suitable for operating magnets which require currents of up to 20 amps at 250 volts. Available in three types: (1) completely manual (2) completely electric

7 REASONS WHY

COOLING TOWERS EQUIPPED WITH FLUOR-WESTERN GEARS GIVE LONGER LIFE WITH LOWER MAINTENANCE COST

1. **A CONSERVATIVE MATERIALS FACTOR OF 1.0** – Fluor-Western Cooling Tower Gears are rated in accordance with American Gear Manufacturer's Association standards calling for a materials factor of 1.0 for gears of a Rockwell "C" 60. *Less conservative* methods of rating permit the use of a materials factor of greater than 1.0 which, with all other factors being equal, will result in the size of the ring and pinion gear unit being reduced in the same proportion that the materials factor used is greater than 1.0.
2. **A STANDARD SERVICE FACTOR OF 1.5** – Fluor-Western Gears have a standard AGMA rated service factor of 1.5 which means that by *standardizing* on this service factor, Fluor customers are assured that the gear unit is designed for continual operation using electric motors or turbines.
3. **STRADDLE MOUNTED PINION** – Fluor-Western gear units feature a straddle mounted pinion. Far superior to the common cantilever type mounting, this Fluor-Western method of supporting the pinion between two rugged, long life bearings minimizes deflection, insures a smooth wear pattern across the gear teeth with quieter operation.
4. **SPIRAL BEVEL GEARS CASE-HARDENED** to 60 Rockwell "C" hardness calling for a materials factor of 1.0... gives longer service life than worm gears or flame-hardened bevel gears.
5. **WEBLESS-TYPE RING GEARS** which are much more rigid than web-mounted gears.
6. **A 100,000 HOUR MINIMUM B-10 BEARING LIFE** – The majority of bearings have a B-10 life in excess of 100,000 hours. In many instances, bearing life can be considered infinite.
7. **2 NEOPRENE SEALS** mounted back-to-back on the input shaft give *positive* protection against moisture leakage.



FLUOR PRODUCTS COMPANY OFFERS A GEAR PARTS REPLACEMENT CONTRACT!

To assure you of a fixed maintenance cost, Fluor Products Company offers a contract for gear parts replacement on new cooling tower installations.

FLUOR PRODUCTS COMPANY

A Division of The Fluor Corporation, Ltd.

MANUFACTURERS AND FABRICATORS OF COOLING TOWERS, PULSATION DAMPENERS, MUFFLERS, PREFABRICATED PIPING AND OTHER WOOD AND METAL PRODUCTS

General Offices – WHITTIER, CALIFORNIA

Wood Products Mill – SANTA ROSA, CALIFORNIA

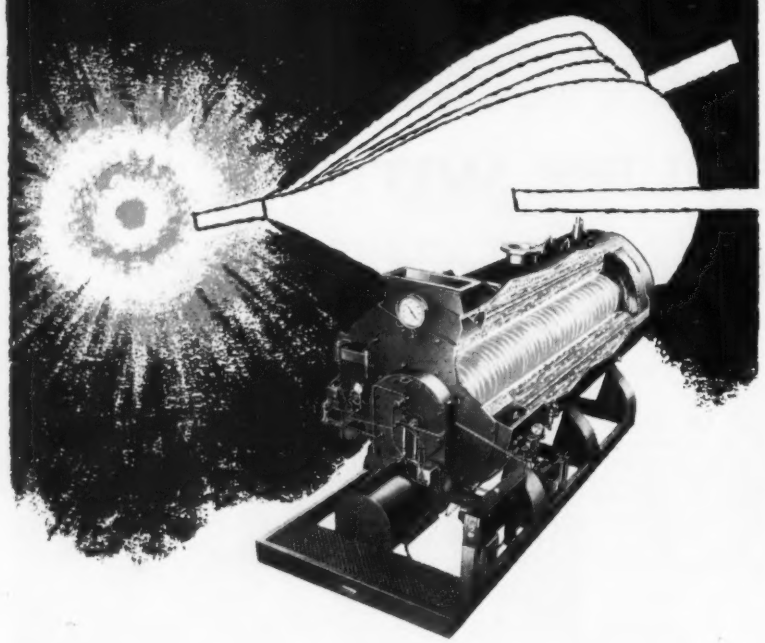
Metal Fabrication Shops – PAOLA, KANSAS

SALES OFFICES AND REPRESENTATIVES IN: Birmingham, Boston, Buffalo, Chicago, Denver, Detroit, Houston, Kansas City, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh, San Francisco, Tulsa.

ASSOCIATES: Fluor Corporation of Canada, Ltd., Toronto; Head-Wrightson Processes, Ltd., London, England.

How do you make an ember glow?

Blow on it!



It takes air to promote combustion and when air enters the Cyclotherm combustion chamber at a tangent and with velocity up to 200 mph, really efficient combustion results. The air, assuming cyclonic shape and motion, combines with the fuel to form a flaming vortex spiraling the entire length of the firetube. This Cyclonic Combustion achieves 65% heat transfer efficiency in the firetube alone. An additional 15% is produced in the single pass of return tubes. Cyclotherm guarantees a minimum of 80% efficiency in only two passes.

Cyclotherm also includes an electronic control system for automatic operation. On models up to 60 hp burner automatically shuts off when steam demands are satisfied; resumes when steam is again needed. On larger models, precision modulation automatically regulates firing rate from 30% to 100% without loss of efficiency.

A complete package Steam and Hot Water generator, Cyclotherm is designed, built and assembled by Cyclotherm Division, National-U.S. Radiator Corp., with one manufacturing responsibility behind the entire job. Models 18 to 750 hp; 15 to 200 psi; burns oil and/or gas.

Among additional Cyclotherm advantages are:

- From cold start to full power in 15 to 20 minutes
- No stack—only a simple flue
- Maintenance costs cut 30% to 50%
- No special foundation needed
- A worldwide service organization
- Saves one-third the space required by other package boilers.

YEARS AHEAD IN STEAM GENERATION
CYCLOTHERM®
Steam & Hot Water Generators
Cyclotherm Division,
National—U. S. Radiator Corp.
25 E. First St., Oswego, N. Y.

Clip to your letterhead

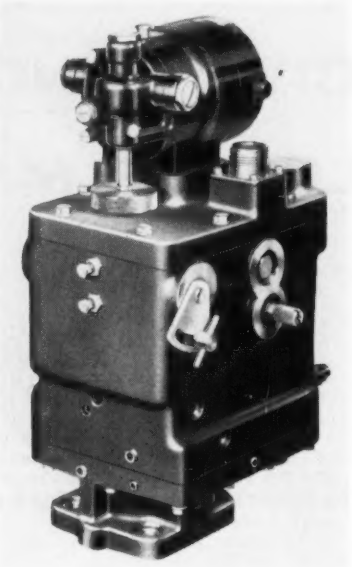
Send me your new booklet "Cyclotherm Cyclonic Combustion"

More EQUIPMENT NEWS

Begins on page 166

start with remote control (3) electric start, remote control . . . less battery charging generator.

D W Onan & Sons, Inc, 2515 University Ave S E, Minneapolis, Minn.



Load-sensing governor

537 • Unit is designed for use with engine driven generator sets. Governor senses a load change in generator output and within one hundredth of a second physically moves the diesel throttle to adjust for a new load. This adjustment is a close approximation, and is followed by a precise adjustment by the speed sensing element of the governor.

Woodward Governor Co, 5003 N 2nd St, Rockford, Ill.

For more details on these items, use post cards p 175. Identify your request with item number.

Variable speed drive

529 • Variable speed drive is capable of maintaining any speed in its range within ¼ of 1% accuracy regardless of load fluctuations, says manufacturer. It is also said that this speed sensitive control can be adapted to any Vari-drive for industrial applications requiring exact speed regulation.

U.S. Electrical Motors, Inc, Box 2058 Terminal Annex, Los Angeles 54, Calif.

Lightning arresters

530 • Self-supporting lightning arresters, in ratings from 48 to 336 kv, are designed primarily for large substations and mounting on power transformers. These units are said to require less mounting space

For you

CLARAGE FAN COMPANY
619 Porter St., Kalamazoo, Michigan

Please send me literature on:

- ☐ Type NH fans for ventilating, air conditioning, and industrial services
- ☐ Type XL fans for industrial air and material handling
- ☐ Type CI cast iron fans
- ☐ Ready Units—complete, "packaged" fans
- ☐ Service Manual—information adaptable to any air handling job, 68 illustrated pages
- ☐ Unit Heaters
- ☐ Mechanical Draft Equipment
- ☐ Air Conditioning Units, Air Washers, etc.
- ☐ General Catalog

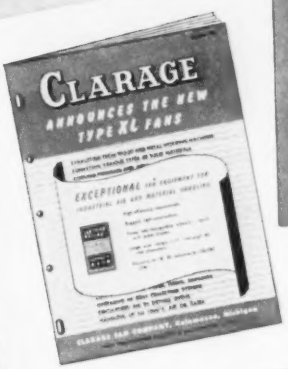
NAME_____

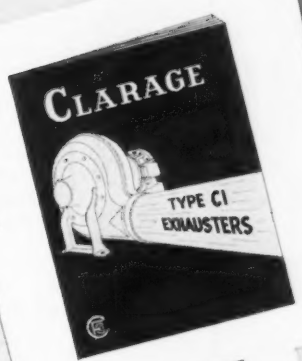
FIRM_____

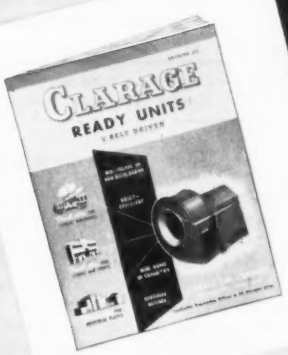
ADDRESS_____

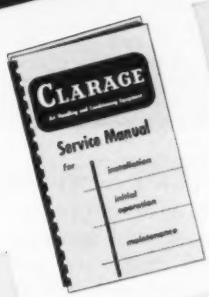
CITY_____ STATE_____

Detailed information on dependable Clarage Fans









These plus other catalogs are available for the asking. Simply use coupon above. Clarage specializes — builds air handling and conditioning equipment exclusively. This concentrated know-how will mean a lot to you regardless of the size or type of your requirements in our field.

CLARAGE

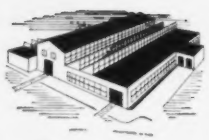
... dependable equipment for making air your servant

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

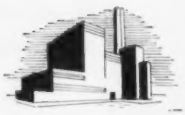
Control enclosures and panels

fabricated by

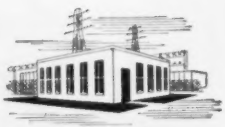
KIRK and BLUM



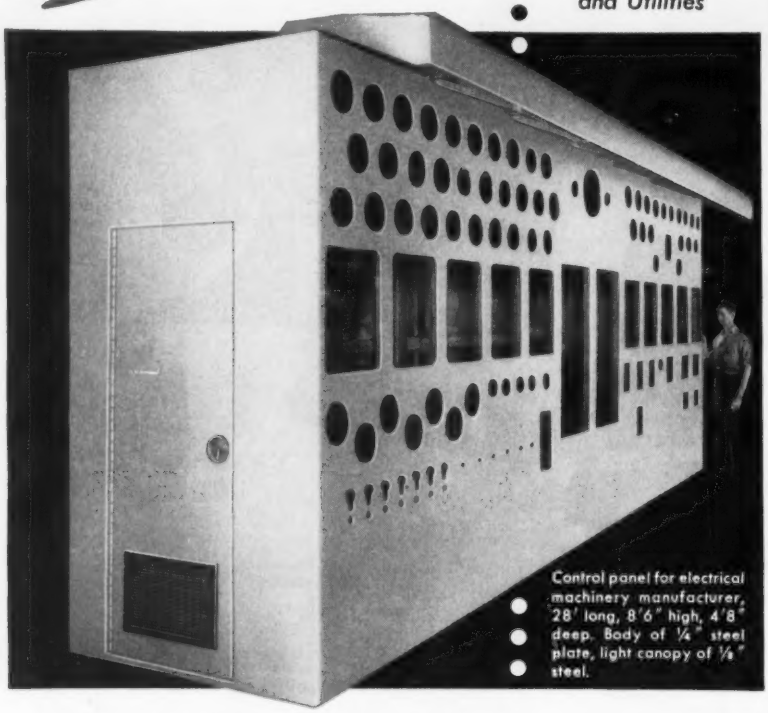
For Industry



Power Plants



and Utilities



Control panel for electrical machinery manufacturer, 28' long, 8'6" high, 4'8" deep. Body of ¼" steel plate, light canopy of ⅛" steel.

- CONTROL DESKS and PANELS
- SWITCH GEAR HOUSINGS
- CUBICLES
- TRANSFORMER HOUSINGS and TANKS
- ELECTRICAL ENCLOSURES
- TEST STANDS
- VENTILATING LOUVRES
- INSTRUMENT PANELS

Whether you require panels for 1 or 100 instruments . . . Kirk & Blum is equipped to fabricate them to your most exacting specifications. We offer exceptional experience and facilities for fabricating parts and assemblies of sheet steel, light plate, stainless, aluminum, monel and other alloys in gauges to ½".

Write for your copy of the latest KIRK & BLUM Electrical Enclosures Booklet. For prompt quotation, send your prints to The KIRK & BLUM Mfg. Co., 323 Forrer St., Cincinnati 9, O.

KIRK & BLUM

METAL FABRICATION

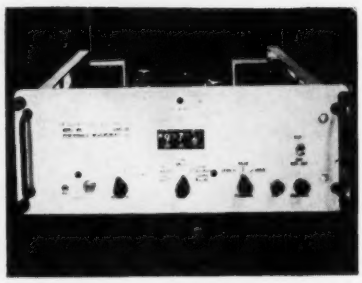
More EQUIPMENT NEWS

Begins on page 166

and no bracing or supporting structures.

Reduction in height of arrester columns is accomplished by arranging three stacks of elements in a single porcelain housing. Although the stacks are physically in parallel, they are electrically in series.

Westinghouse Electric Corp,
P O Box 2099, Pittsburgh 30, Pa.



Vacuum tube voltmeter

532 • Digital reading ac-dc vacuum tube voltmeter features a three-digit register. According to manufacturer, it is designed specifically for research and testing applications, where reading speed and accuracy as well as instrument accuracy are of prime importance.

Small indicator lights on instrument reduce error probabilities: decimal lights point off the decimal place on the register; plus and minus lights show whether the measured quantity is positive or negative; an off-scale lamp illuminates when the measured quantity is larger than the register capacity.

Performance Measurements Co,
15301 W McNichols Road,
Detroit 32, Michigan

For more details on these items, use post cards p 175. Identify your request with item number.

Instrument air filters

539 • Units are designed to remove fine dirt particles and entrained liquid droplets from compressed air streams. They are available in two types.

Where processes or instruments require relatively small quantities of extremely clean compressed air, instrument air filters with special felt type filter media are used.

When air temperature at filter is over 200 F, instrument air filters of metal media type are recommended by manufacturer. Built of metal disc type design, these instrument air filters are said to operate under the higher temperatures with no change in performance characteristics.

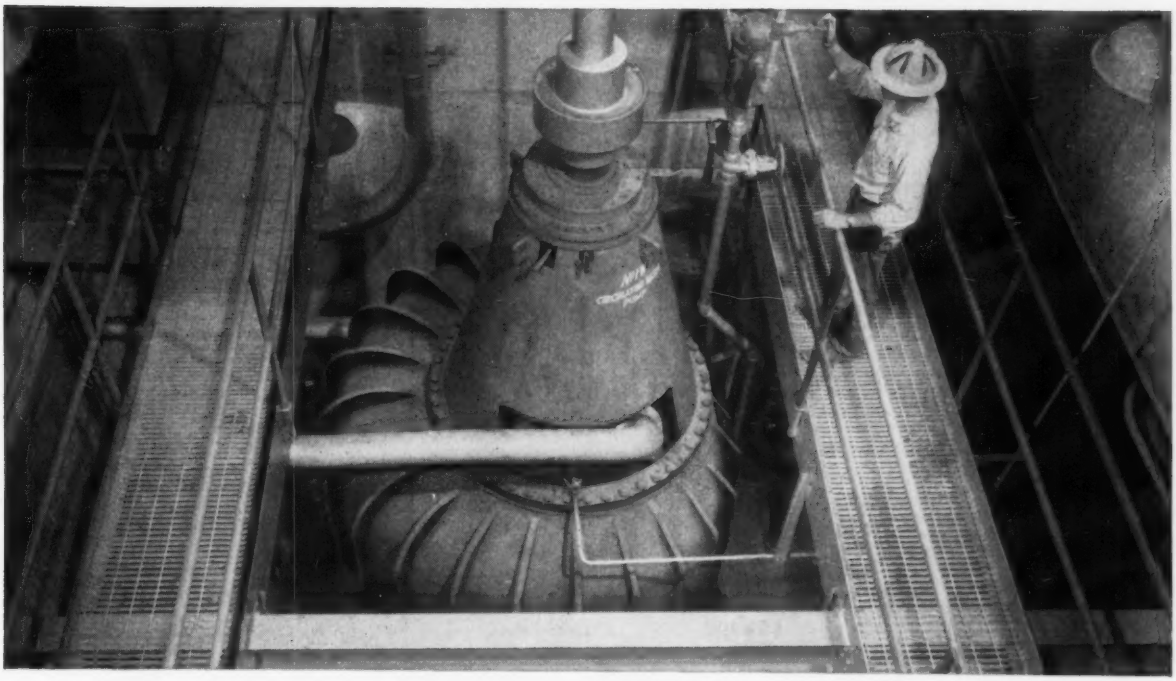
Air-Maze Corp,
25000 Miles Rd, Cleveland 28, Ohio

Direct-writing oscillograph

540 • Unit is designed with an RMS voltage insulation of 5000 volts. It is said to be particularly suited to recording power line

Allis-Chalmers

PUMPS Meet Power Plant Requirements



Heavy-Duty Construction Helps Assure Service Continuity

At Clifty Creek Plant of the Indiana-Kentucky Electric Corporation, the use of 12 Allis-Chalmers vertical condenser circulating pumps for dry pit installation helps to assure service continuity and reduced maintenance.

Rigid whip-free shaft, protected oil-lubricated bearings, and special new-type rib construction that makes casing stronger and saves space — these are some of the features that make A-C circulating pumps popular throughout the power industry.

For the complete story on how Allis-Chalmers pumps can help you cut costs, contact your local Allis-Chalmers district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.

You get **MORE**... when you specify ALLIS-CHALMERS

Design and construction features like these assure dependable, day-after-day operation — better performance and low operating costs for you.

Benefit from Allis-Chalmers experience in building pumps for every industry. Industry-trained engineers are at your service to aid in selecting the right pump for your application. And, you can get the complete unit — pump, motor, control — from Allis-Chalmers.

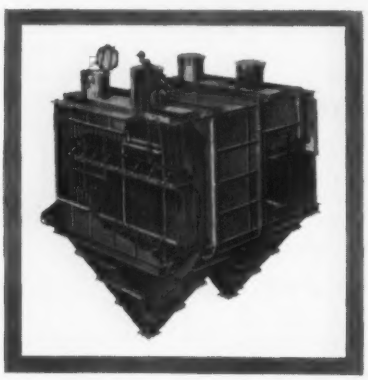
ALLIS-CHALMERS

A-4973

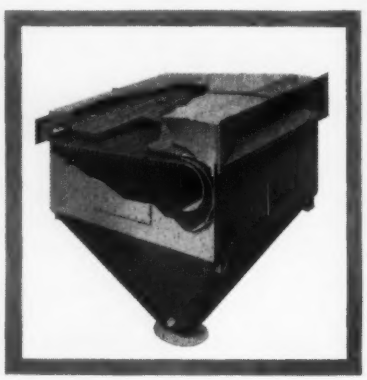
Mastering the double-eddy dust devil leads to extra dust collection efficiency!

DUST IN THIS PART OF THE DOUBLE EDDY WHIRLS UP IN ALL CYCLONES...
BUT BUELL EXCLUSIVE "SHAVE-OFF" TRAPS IT...
HARNESSES THE "DUST DEVIL" FOR EXTRA EFFICIENCY!

Other design features which increase efficiency include large, clog-proof diameter, proper proportioning for maximum dust separation, extra-heavy-gauge, wear-resistant construction . . . features which shave dust collection costs to the minimum!



Buell SF Electric Precipitator also delivers *extra dust collection efficiency*, due to unique Spiralectrodes and Continuous Cycle Rapping.



Buell Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for either natural or mechanical draft installations.

For more specific data about Buell's *extra efficiency*, write Dept. 50-E, Buell Engineering Company, 70 Pine St., New York 5, N. Y.

buell®

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in

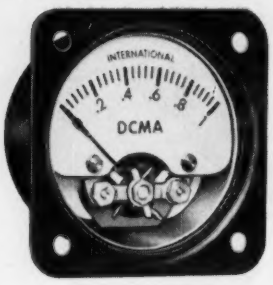
DUST COLLECTION SYSTEMS

More EQUIPMENT NEWS

Begins on page 166

data. With a galvinometer capable of recording at 150 cps, the instrument presents rectilinear or curvilinear records on a reproductible chart. Ink writing elements are easily interchangeable by the operator for either method of recording, according to manufacturer.

Photron Instrument Co,
6516 Detroit Ave, Cleveland, Ohio



Square panel meter

533 • One and one-half inch meter is specifically designed for mounting on edge-lighted panels. Instrument is provided with an external shroud that permits mounting from the front of the panel with a minimum projection from the panel surface.

Standard scale has black markings on a white background. Pointer is lance-type.

International Instruments Inc,
P O Box 2954, New Haven 15, Conn.

For more details on these items, use post cards p 175. Identify your request with item number.

Low ohmmeter

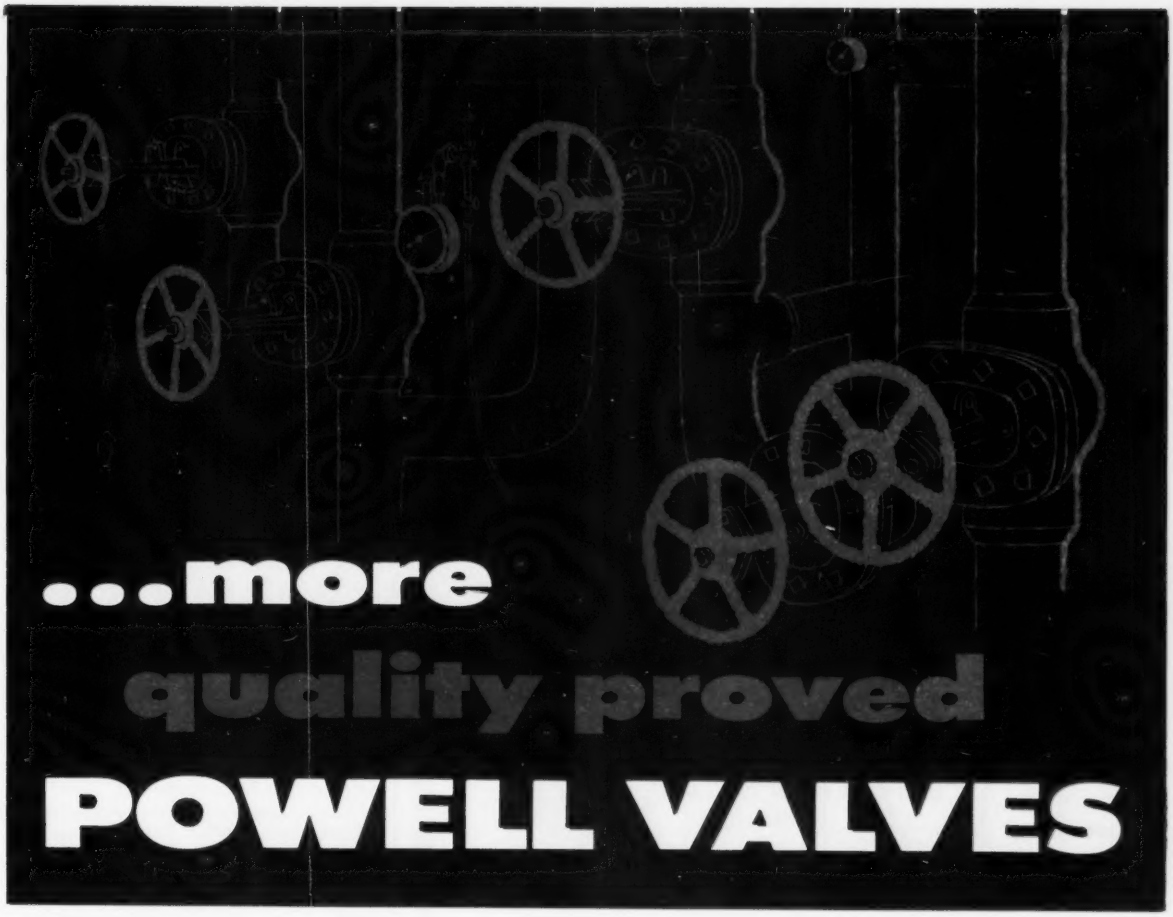
531 • Unit features accurate measurement of low resistance values and utilizes low circuit currents. Gives readings from 0.1 to 25 ohms with an accuracy of 3% of full scale value. According to manufacturer, this accuracy is attained by using expanded scale of suppressed-infinity shunt type ohmmeter. Another feature is its circuit current of 5 ma maximum, which is said to prevent damage to low-current components and promote long battery life.

Simpson Electric Co,
5200 W Kinzie St, Chicago 44, Ill.

Industrial cleaner

541 • Air-operated high-suction industrial cleaner comes in 30 and 55 gal capacities, in four standard models for wet and/or dry applications. Special units are also available for specific materials handling or waste requirements. All units operate by existing compressed air common in most plants.

Since unit is non-electric, there is said to be no explosion hazard. Unit with 1½-in. hose will siphon one gal of fluid per sec-



...more
quality proved
POWELL VALVES

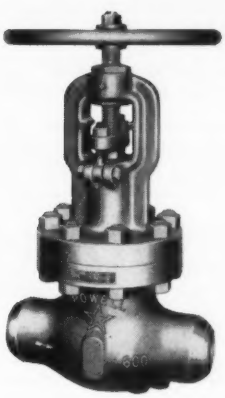


Fig. 6031S-WE—600-Pound Steel Globe Valve for Steam Service. Outside Screw Stem and Yoke.

Fig. 19003—Powell Steel Pressure Seal Gate Valve for 900 Pounds W.S.P.

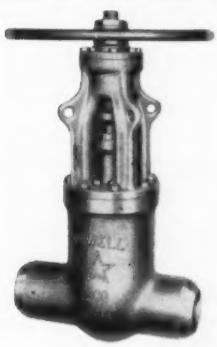


Fig. 2467—Small 300-Pound Stainless Steel O.S.& Y. Gate Valve. For handling boiler feed water treating solutions.

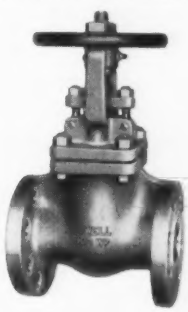


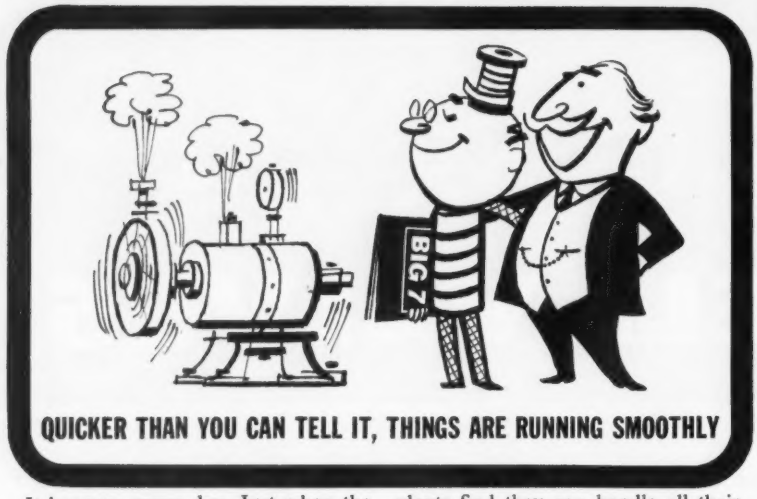
Fig. 1793—Iron Body Bronze Mounted O.S.& Y. Gate Valve for 125 Pounds W.S.P.

made with quality proved materials

Consult your Powell Valve Distributor for full facts about quality proved bronze, iron, steel, and corrosion-resistant valves. For every flow control problem—there is a Powell Valve to solve it . . . *better.*

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

TIME'S A-WASTING, BUT PETE PACKING WILL SOON FIX THAT



QUICKER THAN YOU CAN TELL IT, THINGS ARE RUNNING SMOOTHLY

It happens every day. Just when the boss is pushing against time for more production, the No. 1 pump goes bad because of a faulty packing. Downtime begins to add up, and there's the deuce to pay. But with R/M's Big 7 on the job, things can be kept running smoothly. When a new packing is needed, the right one is always at hand, and with so few to choose from the chance of making a mistake is minimized. Fact is, most plants find they can handle all their packing problems with only 3 or 4 of the R/M Big 7.

So why make trouble for yourself? Get hep to the Big 7 line and cut initial investment costs, reduce your inventories, and make ordering mere child's play.

Have a talk with your R/M distributor. He has all the answers and can show you how to take the problems out of packings.

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M packings for maintenance purposes are sold only through authorized R/M distributors

R M

BIG 7 PACKINGS

RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

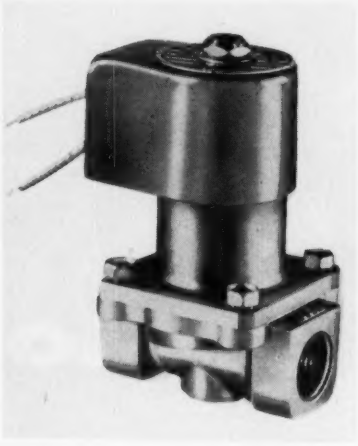
RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

More EQUIPMENT NEWS

Begins on page 166

ond; up to two gal. per second with a 2-in. hose. Since there is no motor, bearings or moving parts, no maintenance is needed.

Vac-u-max Sales Co
1 Montgomery St, Belleville, N.J.



Packless steam solenoid valve

524 • Valve may be used in a variety of applications for automatic control of flow of steam, hot fluids or gases (up to 400 F).

Internal operated solenoid valve has a rugged forged brass body and bonnet. Teflon discs are provided assuring tight shut-off without maintenance problems. Internal operating parts have been designed to last the life of the valve, according to manufacturer. There are no stuffing boxes or sliding glands in packless construction. Valves have low power consumption and mount in any position.

Automatic Switch Co,
391 Lakeside Ave, Orange, N. J.

For more details on these items, use post cards p 175. Identify your request with item number.

Dry film lubricant

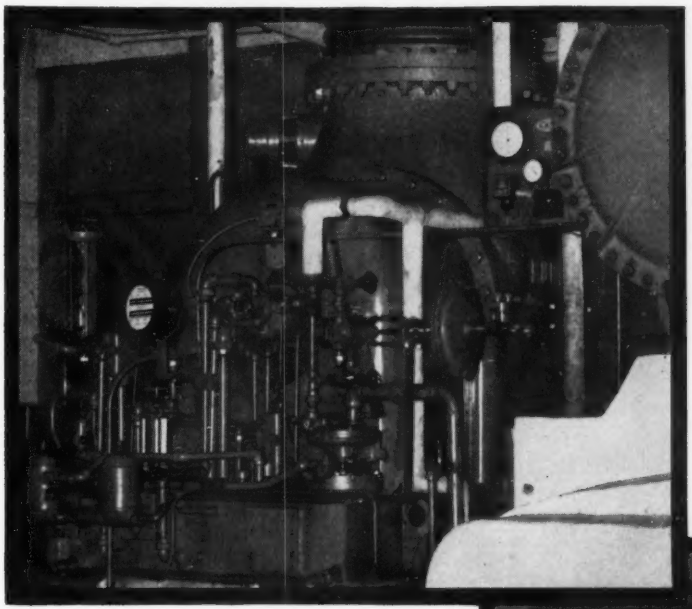
542 • Lubricant is specially formulated for drawing and forming of titanium, titanium alloys, chromium and stainless steels at elevated temperatures.

Lubricant consists of extremely fine particle size graphite combined with a high temperature binder and dispersed in an aromatic solvent system. It has, according to manufacturer, been used successfully for drawing and forming at 600 F to 1400 F and can be applied by either spray or brush. Request details from manufacturer.

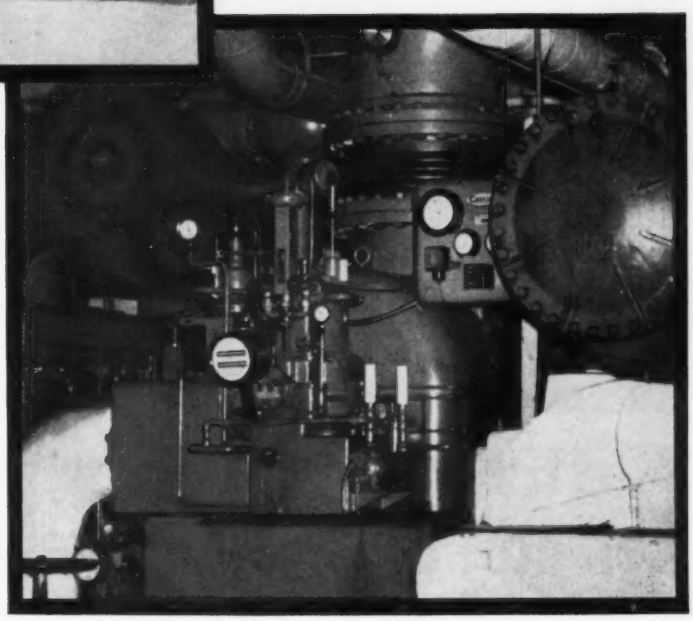
Alpha Molykote Corp
65 Harvard Ave, Stamford, Conn.

Battery cell filler

543 • Filler controls electrolytic level in batteries by adding water to correct height without overflushing. Filler is made in 5 models—three horizontal and two vertical. Filler, connected to a water supply of 30- to 50-psi pressure, consists of a long tube



1948—For air conditioning drive B. Altman & Co. installed a Murray low pressure turbine providing 633 HP at 5010 RPM.



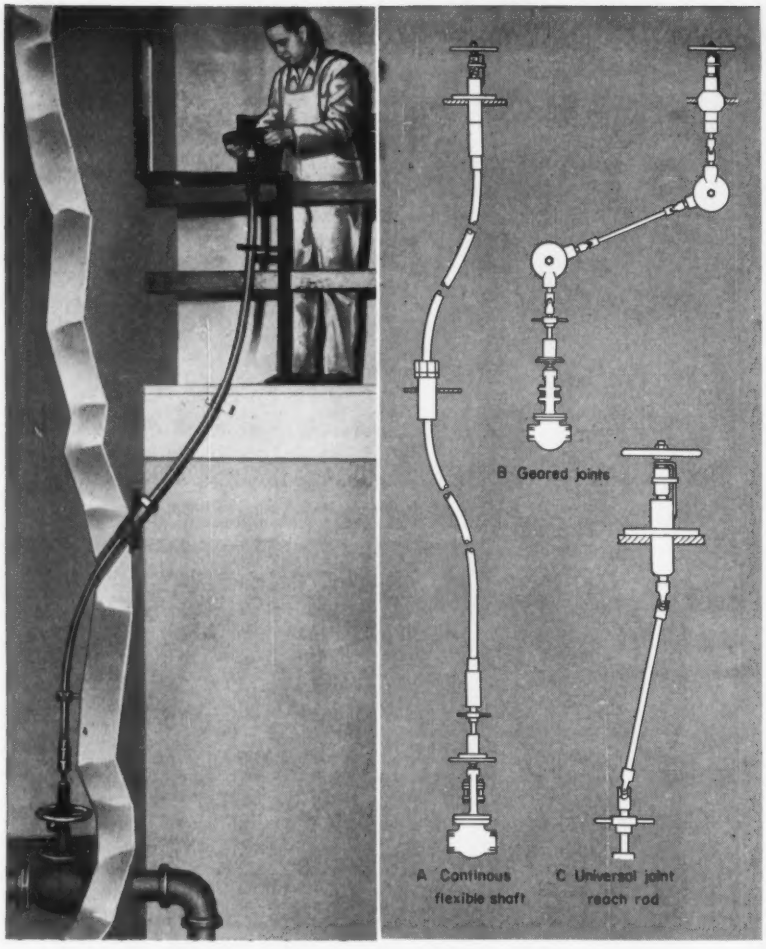
1950—Again B. Altman & Co. selected Murray to drive another air conditioning unit with a 905 HP, 3880 RPM low pressure turbine.

ALTMAN'S SCAVENGES LOW PRESSURE STEAM FOR AIR CONDITIONING DRIVE

B. Altman & Co. in New York City are utilizing low pressure steam to power the air conditioning of their large department store at 34th Street and Fifth Avenue. Economical Murray turbines operating on exhaust steam at only 2# gauge pressure provide the smooth dependable power for the store's two centrifugal compressors. Your low pressure steam can be utilized just as effectively to drive any type of machine. Murray's low pressure turbines are developing as much as 2200 HP in a single turbine and of course Murray's long experience assures you of an added plus value of service and long life.

Consult your local Murray representative who will be pleased to show you ways of utilizing your low pressure steam. MURRAY IRON WORKS COMPANY, Burlington, Iowa.

★★ **Murray Turbines** ★★



Typical station arrangements

Remote control for valves

In recent years, increasing numbers of manual remote controls have been installed in industrial power plants and on nuclear reactors. These systems are popular because they eliminate a great deal of hazardous climbing and permit relatively inexpensive control of a number of widely scattered valves.

Stow Manufacturing Co. makes a complete line of these controls, including: flexible shafting, universal joints and geared joints. These controls also include standard remote stations, intermediate connections and valve couplings for both flexible shafting and reach rods.

Typical installations of this equipment are shown above. Sketch "A" shows a flexible shaft that can be used up to 100 ft. in length and is available in sizes up to 1⅝" diameter. Sketch "B" is an installation using geared joints that operate in any angle through 340°.

For complete design data on all sizes of standard flexible shafts, geared joints and terminals, write for Design Manual 553.

STOW MANUFACTURING CO.
181 Shear Street, Binghamton, N. Y.

More EQUIPMENT NEWS

Begins on page 166

to allow reaching across large batteries and a hydrostatic means of controlling flow.

Cell filler, manually operated by lever, is also said to be suited to washing top of battery cells, preferably before cells are filled and with vent plugs in place. Request details from manufacturers.

Gould-National Batteries, Inc
Trenton 7, N. J.

High-pressure B seal

544 • High-temperature high-pressure B seal permits fast, positive alignment by means of an exclusive lip design that snaps on the flange. Alignment feature permits it to be assembled by touch in tight places.

B seal is used with conventional flanges and three types of couplings. According to manufacturer it has been successfully tested for 1000 lb pressure at 1000 F on small sizes. Seal is available in any size.

Awica Products, Inc, 2113
Stoner Ave, Los Angeles 25, Calif.

Valve actuators

521 • All-metal actuators for control valves are suited for use under difficult conditions such as atomic radiation, high temperature and corrosion. Units are designed for both pneumatic and hydraulic control systems. They are available with suitable valves as complete control units, or as additions to existing valve installations. Some are designed to operate either air-to-air-to-open or air-to-close and are easily reversible in the field.

Robertshaw-Fulton Controls Co,
Box 400, Knoxville 1, Tenn.

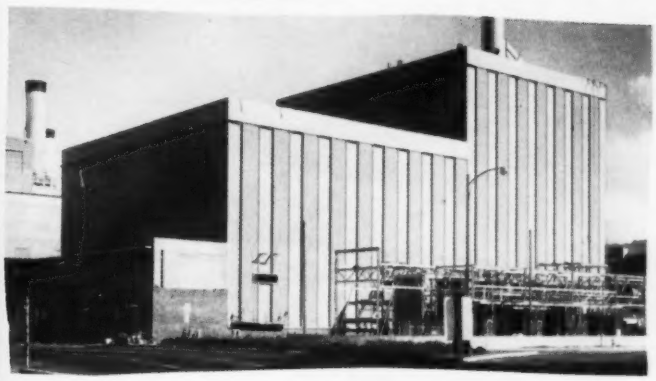
Hydraulic valve

538 • Four-way unit is oil-pressure operated by an oil pilot valve. Oil pressure feature of this hydraulic valve permits automatic operation when oil pilot valve is controlled mechanically.

Designed for 1500 psi, valves are offered in seven sizes: ¼, ½, ¾, 1, 1¼ and 1½ inches. Request details from manufacturer.

Rivett, Inc,
Brighton 35, Boston, Mass.

Maximum control
of temperatures with
PABCO
PRECISION-MOLDED
CALTEMP
a Calcium Silicate
Insulation



Curb expensive heat loss, control temperatures within minimum tolerances with performance-proved Pabco Insulations.
For power plant piping and equipment, a Pabco Insulation insures peak performance wherever temperatures must be maintained up to 1900° F. Pabco's Caltemp and 85% Magnesia insulations are "Precision-Molded" by a patented process in both pipe and block form. For data on technical advantages... case histories... or engineering consultation, write... or call... a Pabco insulation engineer.

PABCO

INDUSTRIAL INSULATIONS DIVISION

Fibreboard Paper Products Corporation • San Francisco 19 • Chicago 54 • Houston 4 • New York 16 • Los Angeles

BOILER GASKETS

Both Popular Types

Wire-inserted woven asbestos and spiral wound metal-asbestos—for manholes, handholes and tube caps of all makes of stationary and marine boilers, water walls, economizers and other boiler accessories.

ask your BELMONT Distributor

Such leading Packing Distributors as:

M. F. Murdock Co., in Akron

and

Standard Supply & Hardware Co., in New Orleans

are ready to serve you promptly and helpfully, wherever you are.

Write for Catalog

The Belmont Packing & Rubber Co., Butler & Sepviva Sts., Phila. 37, Pa.

BELMONT

MARMADUKE

Continued from page 154

even on the coldest day of the year.

"A month later, suction was changed to No. 2 storage tank and that's when the trouble started. Discharge pressure nose-dived to 18 psi and the suction gage sky-rocketed to 28 in. vacuum. Oil temperature in No. 2 tank was about 80 F. Because the pump didn't supply enough oil to carry the heating load, the operator changed suction back to No. 1 tank.

"Next day the building manager sent the oil contractor an SOS. He showed up with two of his strong arm boys to shoot the trouble. His first guess was that a relief valve in the fuel-oil line had stuck open and was sending oil back to the storage tank. I guess he didn't notice the high vacuum on the pump. But after opening the relief valves he had to junk that theory. Each time he changed suction back to No. 1 tank, everything was OK again. So trouble *had* to be with No. 2 tank.

"The contractor checked the tank, then decided the 80-F oil was too cold. His boys ripped the lagging off the suction line for a few feet and wrapped electric heating cables around it. But even when the oil hit 90 F—no dice. He could think of only one other thing.

" 'That suction line is clogged,' he finally announced. 'We'll have to empty that tank and make an internal inspection. Chances are one of the welders left his old britches or something inside—that's happened to me before. I'll get four of my biggest fuel-oil trucks over here and pump that oil into them. Then we'll go inside the tank and find the trouble pronto. But I can't do that for a few more months until the heating season is over,' he added, 'because I need those trucks badly now.'

"That's when the building manager blew a gasket. He said if something happened to the other tank he'd be stuck and the factory would shut down. Then he'd be in hot water.

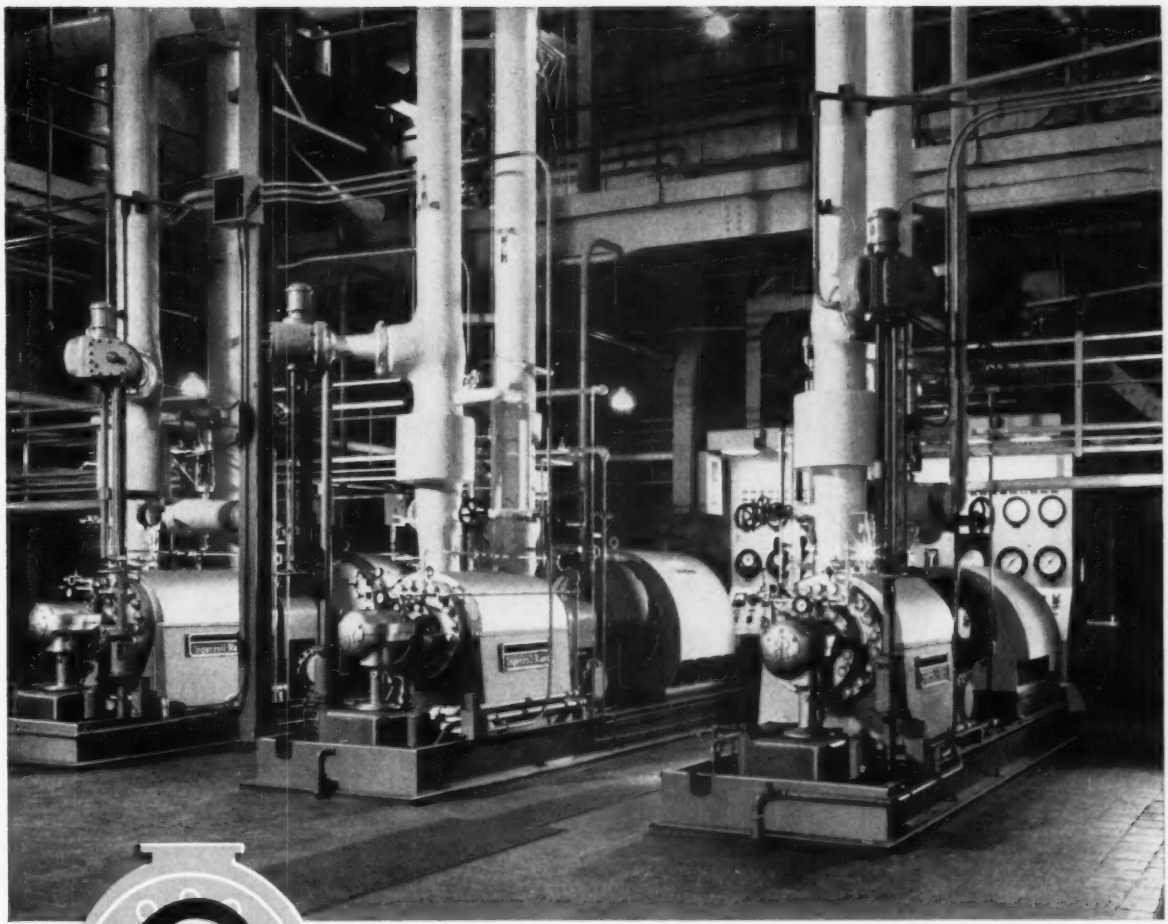
" 'I'm holding the bag,' he squawked, 'because I OK'd this job and you got your money. Now my boss'll come back at me if I can't supply heat.'

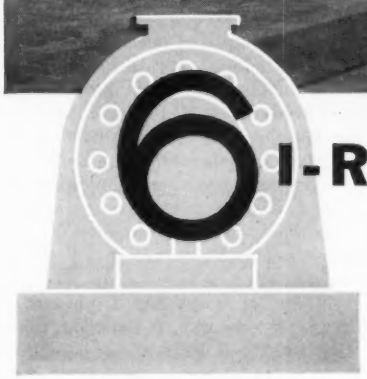
" 'It'll cost me $500 to tie up those trucks now. I can't spare them,' wailed the contractor. 'Besides, nothing'll happen to No. 1 tank.'

"That led to an argument; finally the contractor shoved off in a huff with his boys tailing behind him.

"After telling this story, the manager took me down to the boiler room, told me to look around. Then he scooted back to his busy office.

"In checking No. 2 fuel-oil tank I noticed that her 24 manhole-plate nuts





6 I-R BOILER FEED PUMPS

now serving ALL THREE Generating Units at

MUSTANG STATION

of Oklahoma Gas & Electric Co.

At its Mustang Station, Oklahoma Gas & Electric Company looks to Ingersoll-Rand boiler-feed pumps for the dependable, efficient supply of feedwater to all three of the station's generating units.

Pictured above are three of the four 1100-gpm, 1250-psi discharge units which serve 50-MW Units No. 1 and No 2. The new 100-MW Unit No. 3, put into operation in 1955, is served by another pair of Ingersoll-Rand boiler-feed pumps, each designed for 1770-gpm, 1900-psi discharge. While each generating unit is served by two pumps, each pump is capable of handling full unit load.

All six boiler-feed pumps are of proven Ingersoll-Rand heavy-duty, double-case design, featuring "unit-type" rotor construction to facilitate inspection and servicing.

Ingersoll-Rand boiler-feed pumps are the Power Industry's first choice where efficient performance and maximum dependability are prime considerations. They are available for all capacities and pressures, for any central station or industrial application. Your local I-R engineer can give you full details.

Ingersoll-Rand 10-371

11 BROADWAY, NEW YORK 4, N.Y.

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

If you have TUBES or PIPES from ½" to 12" I.D. you can't clean thoroughly

Try ROTOJET®

Rotojet Tube Cleaners, driven by air, steam or water, are made for straight or curved tubes and pipes from ½" to 12" I.D. Send us your problem.

ELLIOTT COMPANY - ROTO DIVISION
Tube Cleaner Specialists Since 1910
153 Sussex Avenue, Newark, N. J.

MARMADUKE

Continued from page 198

weren't screwed down. Then I traced the tank's vent line. It came vertically out of the tank for a few feet and had five 90-deg L's as it went through various walls, around corners and up outside. All in all, that crazy vent was about 43 ft long, the most complicated one I had ever seen.

"My eyes fell on a small acetylene welding outfit in one corner of the bunker. That gave me an idea. I asked the fireman to help me carry the acetylene bottle outside. Soon as we put her down, I gave him a few dollars and sent him across the street to the delicatessen for hot grilled sandwiches and four cans of beer.

"A few minutes later I was back in the tank room. 'Well, what did you find out?' asked the manager, returning.

"'I can solve your problem without taking anything apart or pumping any oil,' I told him. 'Call the contractor. Tell him I'll straighten this out in a few minutes. He estimated $500 to pump that tank—tell him I'll put him back in business for only $200—and I won't take anything apart.'

"The manager's face lit up. 'I hope you know what you're talking about, because I'll call him right now. I want this thing squared away so I'm not holding the bag.' Just then the fireman showed up with the four cans of beer and sandwiches. 'Let's polish these off while we're waiting,' I said, handing the manager and operator a can apiece.

"The contractor barged in while we were ballasting. 'So you're the mastermind who's going to straighten this out without emptying that tank,' he started, sarcastically.

"'Sure,' I answered, 'I always do things the easy way. If I'm right, you'll save $300 and your client here'll be happy to get what he paid for.'

"'I'll give you the green light on this job—and the dough,' cut in the contractor. 'But I won't buy a pig in a poke. This is our busy season and $200 is peanuts if you can help. But before making the deal, I'd like to know what makes you think you can straighten her out without getting into that tank?'

"'OK,' I answered, handing him a can of beer. 'Relax with this and I'll tell you.' He started to take a drink, then put the can down.

"'How'd you expect me to polish this off?' he asked, screwing up his face. 'You punched only one hole in it.'

"'You just gave yourself the answer to that fuel problem,' I said. "All you have to do is vent No. 2 tank. Then she'll work like No. 1.'

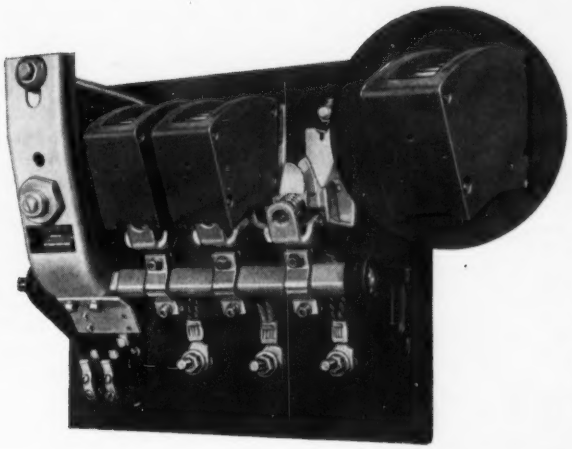
"'But she's got a vent,' he yelled,

for fast arc interruption... without blowout coils

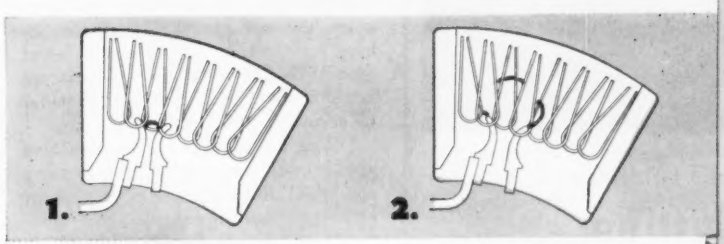
ALLIS-CHALMERS

TYPE 425 CONTROL

featuring ACBO arc-centering blowout chutes for 50 to 400 hp



The advanced electrical design of Allis-Chalmers Size 4, 5 and 6 control incorporates a modern principle of arc interruption for low voltage, high horsepower applications. The *ACBO* arc chute utilizes principles of magnetic action and thermal convection to center, rupture and extinguish the arc . . . quickly. Fast arc interruption assures maximum contactor efficiency, improves performance — greatly prolongs contact and chute life.

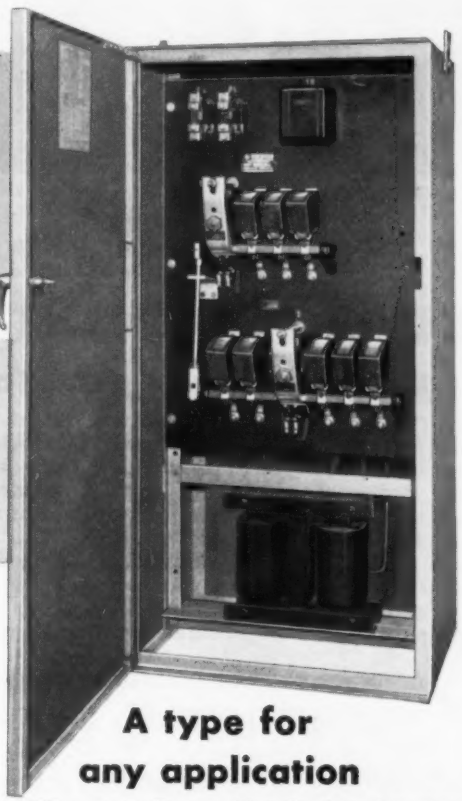


Arc across contacts as they start to open.

Strong blowout action forces arc to center.

Arc rupturing.

Contacts fully open— arc extinguished.



Simplified mechanical design

- Streamlined clapper-type construction eliminates many parts.
- Accessibility simplifies maintenance and inspection.
- Installation is fast and easy . . . sensible enclosure dimensions provide ample wiring space.

A type for any application

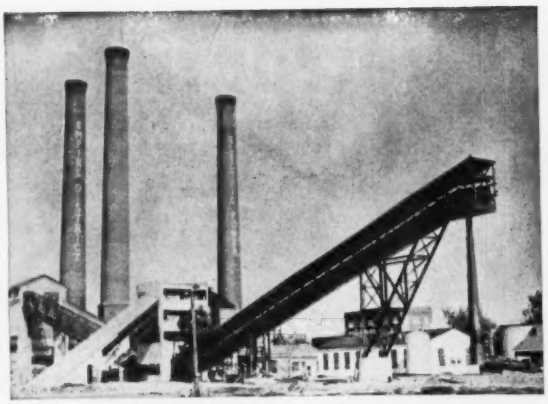
Type 425 control offers a wide selection of starters and contactors for any application. For detailed information, call your A-C Control Distributor or your local A-C District Office . . . or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin. Ask for Bulletin 14B8615.

ACBO is an Allis-Chalmers trademark.

A-5343

ALLIS-CHALMERS

EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.

McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

McNALLY PITTSBURG

"The Men Who Know Coal From The Ground-Up"

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ Title_____

Company_____

City and State_____

MARMADUKE

Continued from page 200

getting pink around the gills.

"'Sure,' I said, 'but she must be partly plugged.'

"'Oh yeah?' he came back. 'If she's plugged, how in hell could we fill her with oil in the first place without rupturing the tank. Just tell me that.'

"'You're almost right,' I agreed. 'But I notice your boys didn't tighten down her manhole plate. That let the plate lift while the tank was being filled. Fact is, that plate acted as a check valve, letting out air while filling, then closing so no air would go in while pumping.'

"That stopped him. Finally he said, 'That still doesn't solve my problem. That manhole plate can't be wedged open to act as a vent, because that'll be a fire hazard. I'll have to tighten down those nuts. And taking that 42-ft vent apart isn't easy either.'

"'You don't have to do anything,' I assured him. 'I blew the vent line back into the tank with a bottle of oxygen a few minutes ago. I figured dirt, filings, or something got into sections of that screwball vent while your boys put her up. Now let's go into the boiler room and start No. 2 fuel-oil pump.'

"'This I got to see,' he said, rushing ahead and changing to No. 2 pump and tank. But that system carried the load same as No. 1 had.

"'You win,' he said, with a big smile on his leathery face, yanking out his check book. He paid me on the spot."

Marmy suddenly yawned, stretched his enormous arms and almost knocked a passing waiter flat. Then he stood up to his full height of 6 ft 4 in. and lit his smelly rope yarn. Heading for the door, he roared one parting blast in his foghorn voice. "The contractor had a load off his mind, the customer had what he paid for, and I had an e 200 fish. And all I did was use a little beer can science."—STEVE ELONKA

Marmy's Mailbox

'Tis here you exchange blasts with the old boy

IS THERE A MARMADUKE?

After reading the Marmy stories for so long, many of us look upon him as a real live person. Fact is, we feel he is one of our old-time friends. I'd like

Klingerit Gaskets

STOP

Costly Joint Failures

Klingerit Gaskets meet the rigid demands to today's high temperatures and pressures by practically eliminating *COSTLY* joint failures. Refineries and Chemical Plants alike have found that Klingerit Gaskets cost less, too! Cost less because they keep joints TIGHTER . . . LONGER, thus reducing high gasket maintenance. Available in thicknesses of ·008" to $\frac{1}{4}$"— sheet size to 60" × 160".

"*Klingerit*" — Universally used sheet packing for super-heated and saturated steam, hydraulic pressures, compressed air, gases, chemicals, oils, spirits and ammonia solvents.

"*Klinger-Oilit*" — Oil resistant sheet packing intended for use in oil refining and distributing as well as for use with methyl-chloride and sulphur dioxide.

"*Klinger-Acidit*" — Acid resisting sheet packing, produced especially to resist hot nitric, hydrochloric and sulphuric acids, as well as most other organic and inorganic acids.

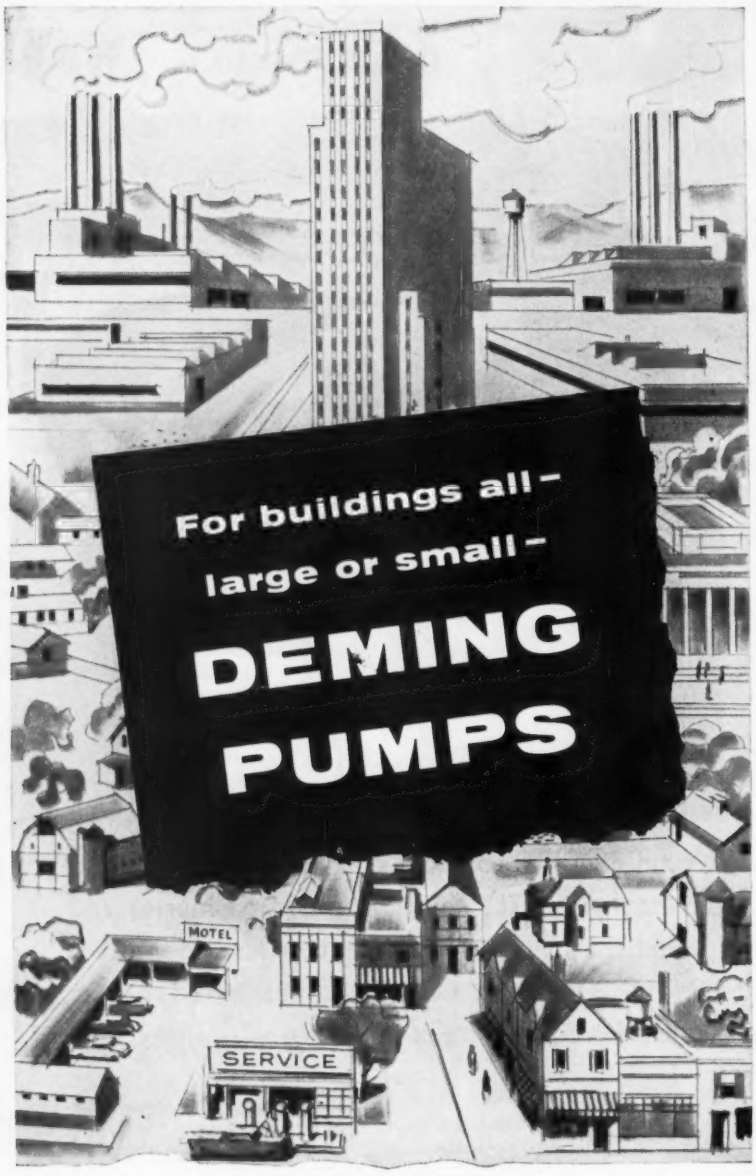
"*Klingerit 1000*" — Wire reinforced sheet packing for extremely high pressures and temperatures. Specially suitable for cylinder head and exhaust joints in internal combustion engines, gas turbines, etc.

RICHARD KLINGER INC. 550, FOURTH AVENUE, BROOKLYN 15, NEW YORK
SOUTH 8-6747

Manufacturing Licensees for Canada

JOSEPH ROBB & COMPANY LIMITED, 5575, COTE ST. PAUL ROAD, MONTREAL, 20, CANADA
Telephone: WILBANK 3181
Branches at: SYDNEY, HALIFAX, OTTAWA, TORONTO, HAMILTON, WINNIPEG, EDMONTON, VANCOUVER, QUEBEC CITY

RICHARD KLINGER LIMITED, KLINGERIT WORKS, SIDCUP, KENT, ENGLAND.



Look to the big Deming line for the right answers to most pumping problems.

Horizontal and vertical centrifugal pumps, air conditioning pumps, sump pumps, sewage pumps, high pressure pumps, boiler feed pumps, condensation return units, vertical turbine pumps, jet pumps, submersible pumps, power driven reciprocating or plunger pumps, and others are included in the big Deming line.

Proper pump selection is important! Free bulletins on all Deming Pumps are available. Name your needs. Write to:

THE DEMING COMPANY
547 BROADWAY • SALEM, OHIO

MARMADUKE

Continued from page 202

your answer to two questions I'm often asked. Is there a Marmaduke? Is there a Bent Propeller Bar?

B C WILLIAMSON, *Cincinnati, Ohio*

EDITOR'S ANSWER: Yes, Mr Williamson, there is a Marmaduke Surfaceblow. He is the engineer in the hand-fired coal-burning plant who keeps steam on the line by rolling up his sleeves to help his fireman when the going gets tough. He is the marine engineer who got his ship back to port after the main engine bearings burned out. He's the engineer who worked 49 hours without sleep to overhaul his diesel engine to get his ship to sea in time.

In other words, he's all the unsung power engineers the world over, on land and sea, who are dedicated to their job —who often spend a night at the bedside of their sick boiler or engine and forget self and family because he is needed to make the right adjustment on his equipment — equipment he often values as much as his own personal belongings.

He is the engineer who often sacrifices all else to his plant—who often is forgotten by the front office and is only thought of as 'the guy in that hot, dirty hole in the sub basement, who keeps burning up all the profits and is always squawking for spare parts.' In other words, Mr Williamson, he is all of us power engineers who have run an assortment of power plants in our time and who are dedicated to our job.

As for the second question: Yes, there is a Bent Propeller Bar. It's the place that tired power engineers stop at 4 am of a cold winter morning after playing nursemaid to a worn out boiler all night so the plant will have steam by 7 am. It's the bar across the street where engineers often drag their sweaty bodies for a thirst quenching beer after rolling in tubes on No. 6 boiler, with the fire room temperature flirting with 140 F. It's the bar where the powerhouse gang gathers after getting the plant going after a breakdown—where they tell a few jokes and slap each other on the back for doing a 2-day job in only six hours.

So long as there is power-plant machinery, and engineers to run them, Mr Williamson, there will always be a Marmaduke Surfaceblow and a Bent Propeller Bar.—STEVE ELONKA

FROM CHEMICAL DEPARTMENT

We look forward to reading Marmy's latest brainstorms here in the design department of E I DuPont de Nemours & Co. I always enjoy his down-to-earth solutions to complicated problems.

ED DUNCAN, *Wilmington, Del.*

why engineers go for Gun-Pakt Expansion Joints

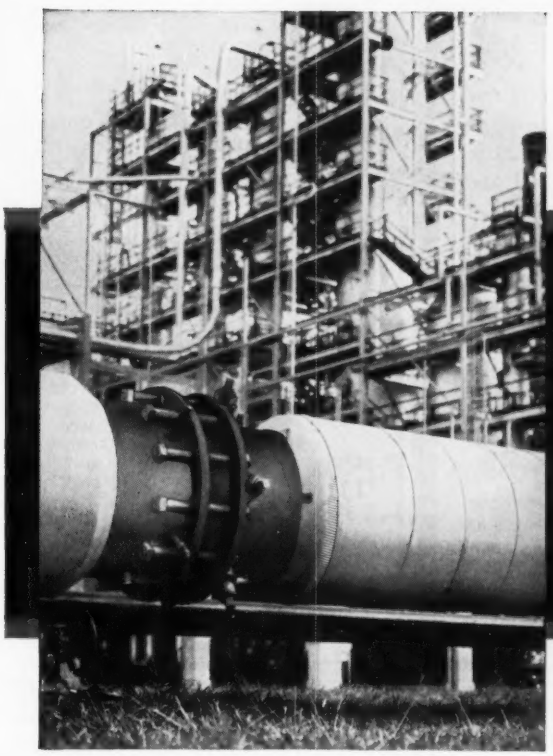
■ Engineers go for Yarway Gun-Pakt Expansion Joints because:

NO SHUTDOWNS. With Gun-Pakt Joints when new packing is needed, it is added under full steam pressure, right on the job—no unpacking, no shutdowns, no service interruptions.

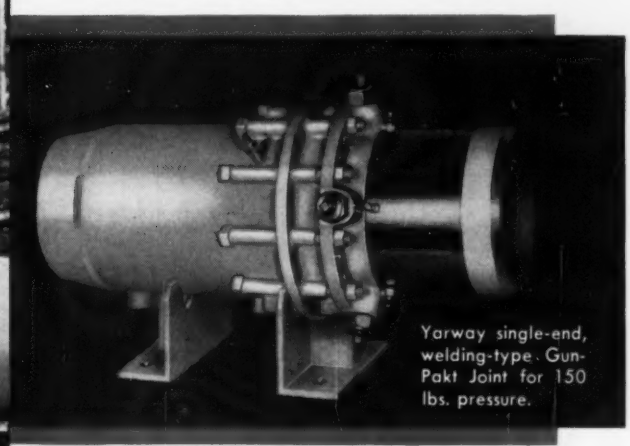
FEWER JOINTS NEEDED. With Gun-Pakt Joints you need fewer joints per length of pipe line, with traverses up to 12" single and 24" double.

LONG SERVICE—NO METAL FATIGUE. Gun-Pakt Joints give long, trouble-free service life—no fatigue failures.

LOW MAINTENANCE. Maintenance records show the costs for servicing Gun-Pakt Joints are very low. One utility reports only 65 cents per year per joint—another reports less than half that.



One of 37 Yarway Gun-Pakt Expansion Joints installed at giant oil refinery on Gulf Coast. Gun-Pakt Joints at this refinery range in size from 1½" to 14".



Yarway single-end, welding-type Gun-Pakt Joint for 150 lbs. pressure.

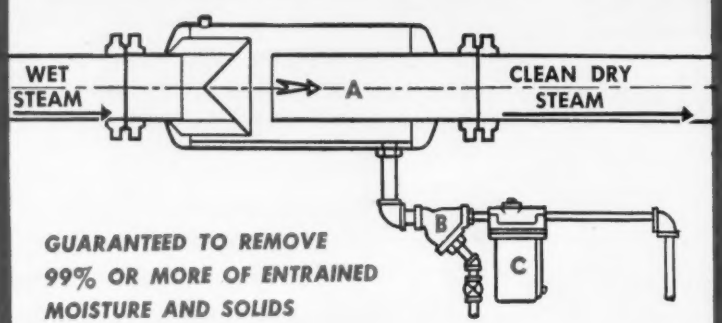
Leading institutions, central heating stations and industrial plants "go for Gun-Pakt" again and again. Write now for latest bulletin EJ-1914.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Penna.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY GUN-PAKT EXPANSION JOINTS

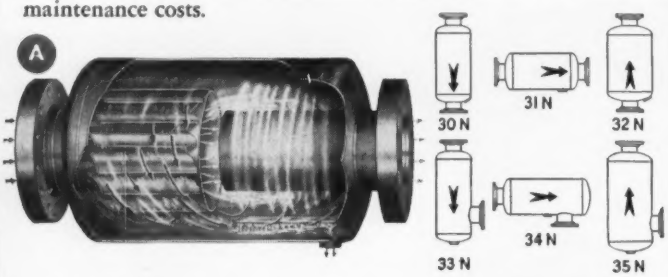
NOW—

The driest, cleanest steam available, is yours with this Wright-Austin equipment

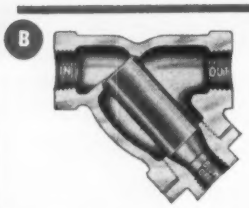


GUARANTEED TO REMOVE 99% OR MORE OF ENTRAINED MOISTURE AND SOLIDS

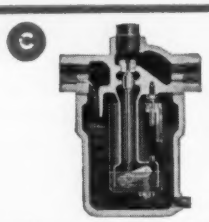
Live steam containing condensate, boiler compound, scale and other foreign matter is detrimental to equipment and is costly to super heat. These Wright-Austin accessories are engineered to give you maximum purification, resulting in lower fuel and maintenance costs.



This Wright Austin separator employs centrifugal force to remove impurities from steam, air or gas flow. The Type 31N, as well as other Models shown, are light weight, compact and sturdily constructed according to the ASME Code.



Foreign matter drains to Wright-Austin "Y" Type strainer which catches solids. These are periodically blown out by opening drain valve.



Condensate flows through strainer to Wright-Austin "Airxpel" Bucket trap. This unit automatically drains condensate as collected.

WRITE FOR NEW CIRCULAR 506-A

WRIGHT-AUSTIN COMPANY

3245 WIGHT STREET • DETROIT 7, MICH.

More FREE LITERATURE

Begins on page 175

sensitive non-retentive magnetic shielding material. Includes seven pages of graphs: B/H curves, hysteresis curves, core loss, Curie temperatures and coatings relative to frequency graph. Magnetic Shield Div, Perfection Mica Co, 20 N Wacker Dr, Chicago, Ill.

9 **Health and safety** precautions against hazards of radioactivity are subject of 4-p bulletin 407. Services for health and safety include accountability (for SS Nuclear Materials Management); criticality precautions (for fuel element fabrication); and complete health physics services. Richard Frankel, Nuclear Science and Engineering Corp, PO Box 10901, Pittsburgh 36, Pa.

10 **Planning fire protection** for structures and equipment associated with power generation and transmission is discussed in 12-p illustrated bulletin. Includes charts, photographs and diagrams. Title: *Power Plant Fire Protection*. Automatic Sprinkler Corp of America, Youngstown 1, Ohio.

11 **Unit fire detectors** are subject of 4-p illustrated brochure MC-107B. Booklet describes horizontal and vertical models, states physical and electrical specs, gives listings and approvals and offers mounting suggestions. Fenwal Inc, Ashland, Mass.

MAINTENANCE EQUIPMENT & MATERIALS

12 **Aluminum jacketing** for insulated lines is described in bulletin and folder. Includes application methods, specs of jacketing and specs for use in ordering. Aseeco, Inc, PO Box 6067, Houston 6, Texas.

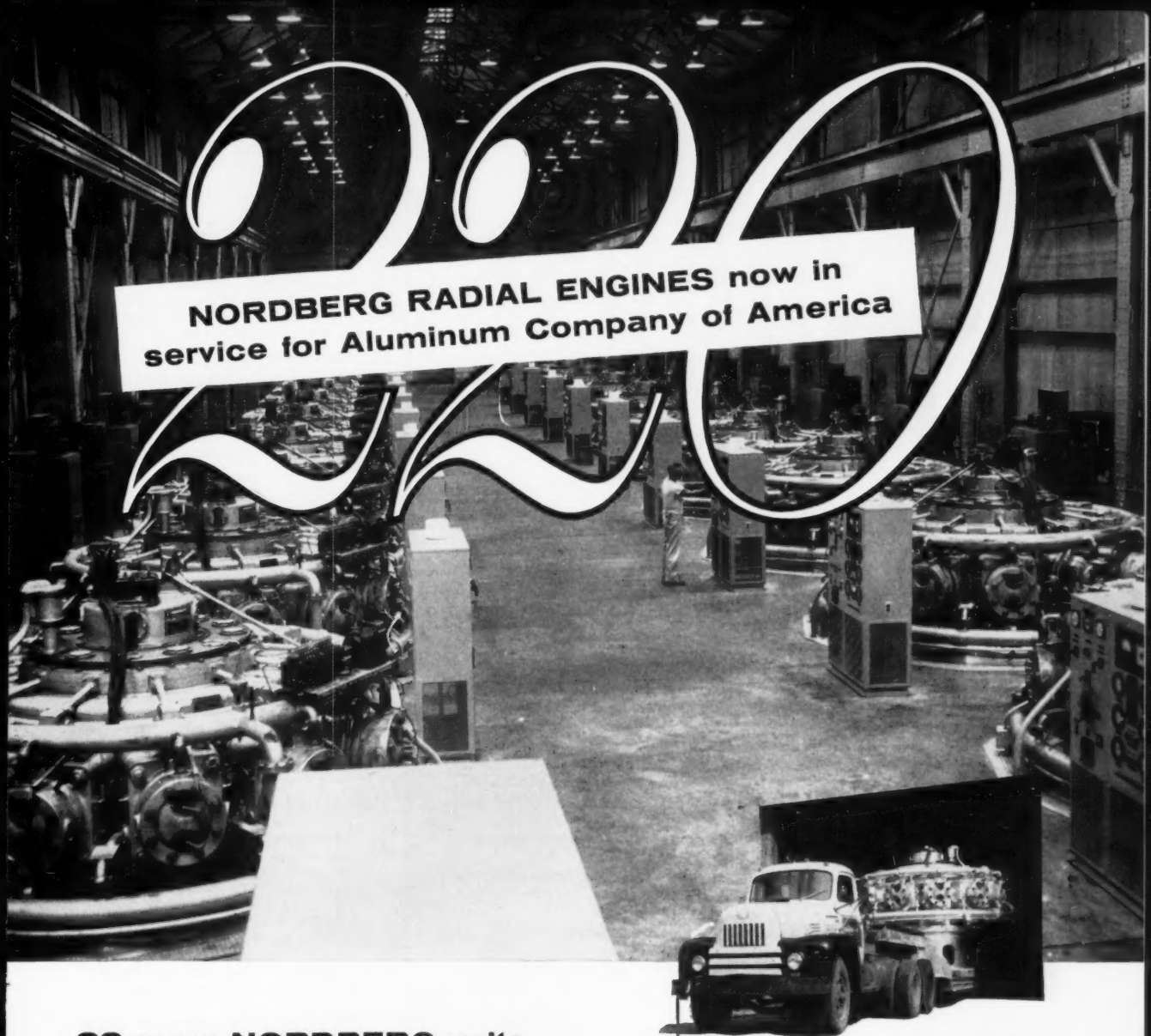
13 **Steel smokestacks,** glass - protected, are subject of 8-p bulletin SS-202. Brochure describes resistance of smokestacks to flue gas condensates and weathering. A O Smith Corp, Milwaukee 1, Wis.

14 **Corrosion control** is subject of 4-p illustrated bulletin of the same name. Semi - technical bulletin contains recommendations for application of paint products to electric light and power equipment. James B Sipe and Co, Industrial Div, Pittsburgh 16, Pa.

15 **Clip-on condenser tube** protectors are described in 3-p bulletin 19B8590. Contains installation data, carries a sketch of a typical erosion pattern on steam side of condenser and design details of patented protector. Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

MATERIALS HANDLING

16 **Portable hoists** are described in 12-p illustrated bulletin 3-16. Contains descriptions and specs of



22 more NORDBERG units now on order will provide nearly 475,000 TOTAL HORSEPOWER

• The compact, lightweight Nordberg Radial engines are shipped as complete factory-assembled units. This 12-cylinder, 2125 hp gas burning engine, loaded on a flat bed trailer, is one of 26 units recently installed by ALCOA at their Point Comfort works.

A total of 220 Nordberg spark fired gas burning Radial engines with a capacity of over 400,000 horsepower have amassed a *startling total of over 8 million hours of dependable operation* at the Point Comfort, Texas smelting works of the Aluminum Company of America . . . by far the world's largest internal combustion engine power station.

As part of its continuing expansion of aluminum production facilities, ALCOA recently ordered 22 additional Nordberg units to provide power for a seventh pot line at Point Comfort. This new line will add 20,000 tons to the operation's installed capacity of 120,000 tons annually . . . requiring well over four million kwh per 24 hours.

The 22 newly ordered Nordberg engine-generator units will raise the power capacity to nearly 475,000 total horsepower, and will be the third expansion of electric power generating facilities for the electrolytic reduction of aluminum by Alcoa at Point Comfort.

These impressive repeat orders by ALCOA testify to the fact that the efficiency and low maintenance of the Nordberg Radial engines have contributed significantly to the lowering of aluminum production costs.

NORDBERG MFG. CO.
Milwaukee, Wisconsin

NORDBERG
DIESEL • DUAFUEL® AND SPARK IGNITION GAS ENGINES

© 1957, Nordberg Mfg. Co.

P157

if

you have any of these troubles:

* **1. SCALE, CORROSION, or FOAMING** *in your boiler operation.*

2. RUST and CORROSION *in your steam and condensate lines.*

3. SCALE, CORROSION, or ALGAE GROWTH *in your cooling or condenser water system.*

4. CORROSION or SCALE *in your hot or cold water tank and lines.*

5. RUST and CORROSION *in your brine or sweet water system.*

6. SCALE *in pumps, water jackets, compressors, coils, lines, or equipment.*

7. SLUDGE and MOISTURE *in your fuel oil supply.*

8. SOOT DEPOSITS *in your furnace combustion areas.*

then . . . let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam and fuel. Check the number or numbers of the problems you have in the coupon below. Get full information.

*** for example**

. . . Western's Boiler Feed Water Treatment consists of special formulas, tailor-made to your specific water and operating condition, to eliminate scale, corrosion and foaming.

Over 65 Years of Know-How In the Chemical Treatment of Water

Chemical Treatment for Water Steam and Fuel

WESTERN CHEMICAL COMPANY

713 Washington Street
Kansas City 5, Missouri

MAIL THIS COUPON TODAY

Send information on the problems checked:

1 ☐ 2 ☐ 3 ☐ 4 ☐
5 ☐ 6 ☐ 7 ☐ 8 ☐

Other_____

Name_____

Firm_____

Address_____

City_____ Zone____ State____

More FREE LITERATURE

Begins on page 175

air, electric and gasoline driven models. Joy Mfg Co, Oliver Building, Pittsburgh 22, Pa.

17 **Conveyor and elevator belts** are subject of catalog 25 CB. Covers tension ratings for vulcanized and metal splices, minimum recommended pulley diameters and minimum belt width for troughing. Raybestos-Manhattan, Inc. Manhattan Rubber Div, Passaic, N. J.

18 **Conveyor** designed for placing concrete is described in 4-p booklet 157. Contains specs, photos and operating features. Fairfield Engineering Co, 342 Chicago Ave, Marion, Ohio.

MECHANICAL TRANSMISSION

19 **Ball bearing equipment** is subject of 6-p bulletin 2489. Contains technical data on selection and application. Link-Belt Co, Dept PR, Prudential Plaza, Chicago, Ill.

20 **Concentric shaft** and right angle speed reducers are subject of 22-p bulletin 1105. Hp and torque ratings are given, as well as dimensions, overhung load, thrust capacities and application pictures. The Falk Corp, Dept. 255, 3001 W Canal St, Milwaukee 1, Wis.

METERS AND INSTRUMENTS

21 **Electronic potentiometer** instruments are subject of 4-p illustrated data sheet ND46-33(23). Lists features, specs and ranges for three models. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

22 **Pneumatic pressure transmitter** for vacuum or pressure measurement is subject of spec sheet S705-1. Contains ordering information, table and diagram. Minneapolis-Honeywell Regulator Co, Industrial Div, Wayne and Windrim Aves, Philadelphia 44, Pa.

23 **Control system** for make-up water flow, chemical feed and blowdown rate of cooling towers is described in 4-p illustrated bulletin 1050. Contains diagrams and photos; describes uses. Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

24 **Balance positioner** is subject of 16-p illustrated bulletin UB57. Contains schematic drawings, complete specs and optional accessories. Aronson Machine Company, Arcade, N. Y.

25 **Accessories for gages,** dial thermometers and recorders are subject of 4-p illustrated folder 600. Contains tables, cutaway drawings and dimensions. United States Gauge, Sellersville, Pa.

26 **Flowmeter** is described in 4-p product data sheet 463-170. Illustrates operation of instrument

ANCHOR

Carbonite

PLASTIC PACKING

. . . Recommended to solve costly packing problems!

Plastic packings of The Anchor Packing Company have come into extensive use. Carbonite, a plastic packing of many uses, has effectively proved its value in solving various packing problems.

Carbonite in coil form is easy to use. Rings are easily cut. A unique feature is it contains no tar or wax, and the absence of cotton in the structure insures against packing shrinkage due to the carbonizing or burning out of the cotton. It is not affected by heat.

To quickly, efficiently and economically solve your packing problems, specify Anchor Carbonite. Write us today.

DISTRICT OFFICES

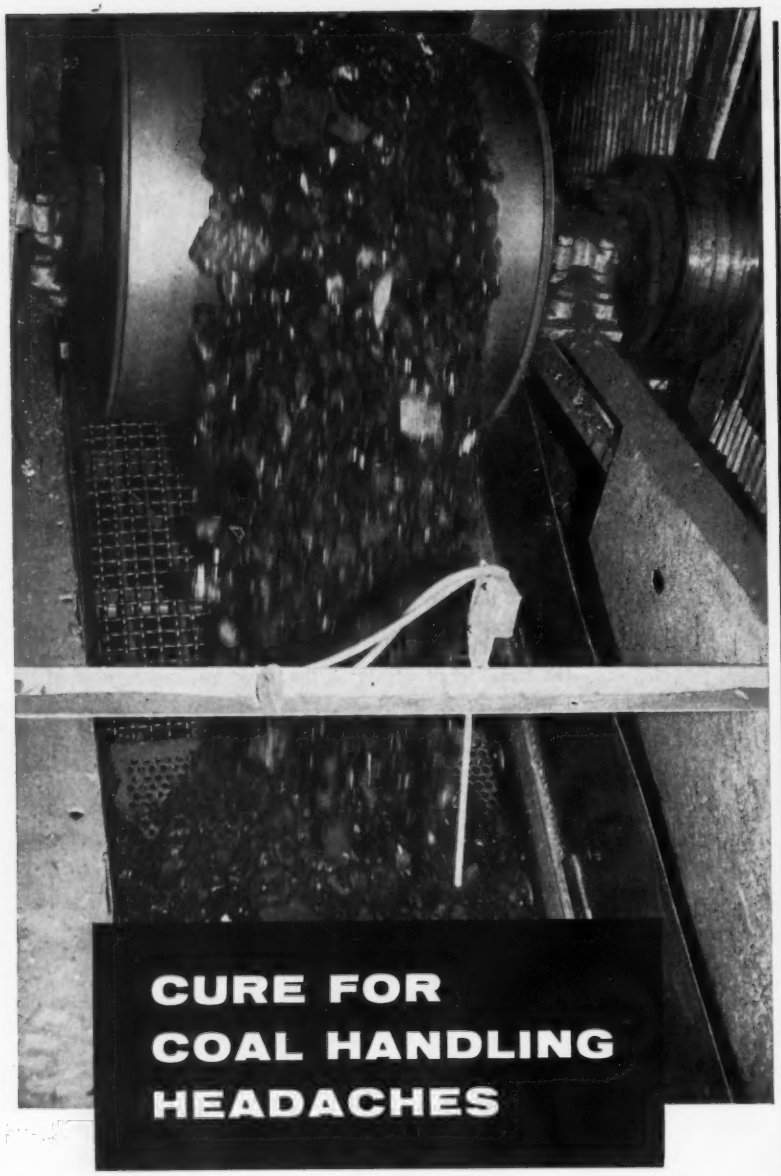
BALTIMORE, MD.	HOUSTON, TEX.	NEW YORK, N.Y.
BOSTON, MASS.	INDIANAPOLIS, IND.	PHILADELPHIA, PA.
BUFFALO, N.Y.	LOS ANGELES, CAL.	PITTSBURGH, PA
CINCINNATI, OHIO	MILWAUKEE, WIS.	SAN FRANCISCO, CAL.
CHICAGO, ILL.	MINNEAPOLIS, MINN.	SEATTLE, WASH.
CLEVELAND, OHIO	MONTREAL, CANADA	ST. LOUIS, MO.
DAYTON, OHIO	NEW ORLEANS, LA.	TOLEDO, OHIO
DETROIT, MICH.		WILMINGTON, CAL.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM. PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE



To get out more coal at less cost, Zeigler Coal & Coke Corporation's Bradbury Mine uses a Hewitt-Robins belt conveyor system. Coal, transferred from 5,000 ft. of panel belts to a 4,000 ft. mainline conveyor system, is discharged to a 42" wide, 950 ft., 16° slope conveyor traveling at 450 FPM. This conveyor delivers 450 TPH to an H-R Vibrex Screen which removes fines ahead of the breaker.

The underground haulage system, including conveyor belts, idlers, and machinery, was designed, engineered, and manufactured by Hewitt-Robins. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

HR HEWITT-ROBINS

CONVEYOR BELTING AND IDLERS... POWER TRANSMISSION DRIVES
INDUSTRIAL HOSE...VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

More FREE LITERATURE

Begins on page 175

schematically and lists applications in power field. Includes interior view, specs and identifies various components. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

PIPING, VALVES, FITTINGS and SPECIALTIES

27 **Valve** for pressure reducing and regulating is subject of 2-p illustrated bulletin 981. Includes photos and cross-sectional diagram, specs, pressure and temperature ratings, capacity chart, installation instructions and other data. A W Cash Co, PO Box 551, Decatur, Ill.

28 **Lubrication fitting** is described in 4-p illustrated bulletin BU-61. Contains photos and drawings; table of test results. Keystone Lubricating Co, 3100 N 21st St, Philadelphia 32, Pa.

29 **Hydraulic pilot valve** is described in catalog sheet containing photos, cutaway diagrams, valve features, recommended applications and spec instructions. Atlas Valve Co, South & Jefferson Sts, Newark 5, N. J.

WATER TREATMENT

30 **Pressure filters,** horizontal, are described in 4-p illustrated bulletin 6322. Contains information on operation, control, filter bed materials, design features and available accessories. Cochrane Corp, 17th St, below Allegheny Ave, Philadelphia 32, Pa.

31 **Waste treatment** is subject of reprint 72 titled *Sall Mountain's Unusual Effluent Treatment Plant* is available from manufacturer of water and waste treatment equipment. Infilco Inc, Tucson, Ariz.

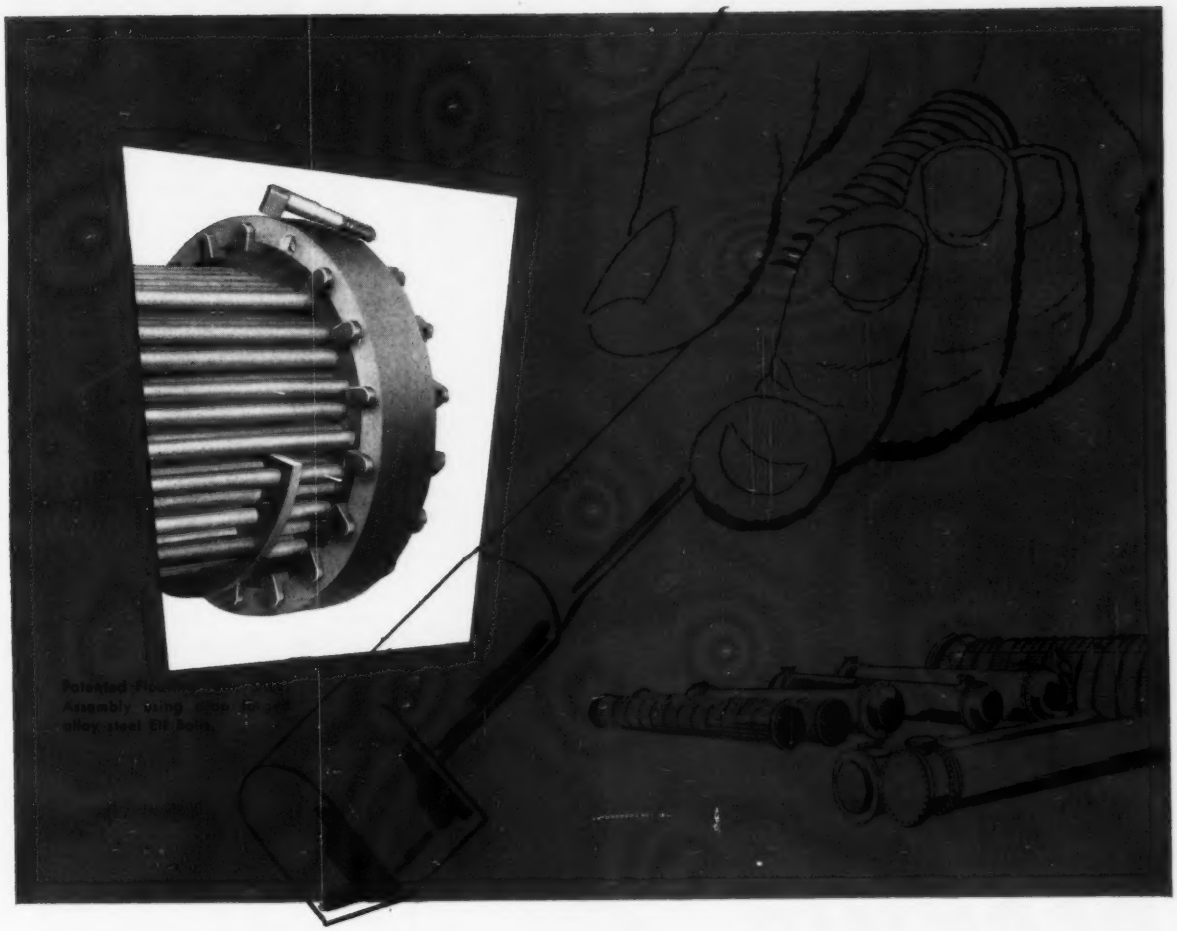
WELDING

32 **Arc welding machine** and accessories are subject of 43-p catalog 1340. Contains specs for amp ratings to outside dimensions. Air Reduction Co, Inc, 150 E 42nd St, New York 17, N. Y.

33 **Electrode** data book contains 24 pages of information on AWS-ASTM arc welding electrode specs; how to estimate electrode consumption; and factors in selecting electrodes. National Cylinder Gas Co, 840 N Michigan Ave, Chicago 11, Ill.

LUBRICATION

34 **Heavy oil preparation** for combustion is discussed and packaged fuel oil pump and heater sets are illustrated in bulletin 15. Three-page illustrated bulletin includes engineering data table. Walter H Eagan Co, Inc, 2336 Fairmount Ave, Philadelphia 30, Pa.



This Ell Bolt is the Key to leak control

The patented Ell Bolt construction employed on Vogt floating head heat exchangers is the answer to re-assembly without distortion or leak development.

Cover may be removed by simply loosening the Ell Bolt nuts and disengaging the Ell Bolt heads from the "lock notches." No misplacing of Ell Bolts can result — and tightening is easy and positive — absolutely leak proof. Send for Bulletin HE-6. Address Dept. **24A-XP.**

HENRY VOGT MACHINE CO., P. O. BOX 1918, LOUISVILLE 1, KY.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati, San Francisco

Vogt

OTHER VOGT PRODUCTS
Drop Forged Steel Valves, Fittings and Flanges in a complete range of sizes • Petroleum Refinery and Chemical Plant Equipment • Steam Generators • Heat Exchangers • Ice Making and Refrigerating Equipment.

HEAT TRANSFER EQUIPMENT

PRESSURES:
2000 psi
TEMPERATURE
1200°F.

DON'T WORRY

THEY'RE PACKED WITH

JOHN CRANE

SEVERE SERVICE PACKING

Style 177AI

Here is the tough, dependable packing you've been looking for. Style 177AI is built to take punishment . . . to easily withstand pressures as high as 2000 psi . . . remain resilient at temperatures to 1200°F. It's a packing that will give you the kind of service you've always wanted in high temperature valves, soot blowers, gauge glass fittings and similar applications.

Style 177AI is dry graphite lubricated to reduce friction to a minimum. Each strand of the closely braided asbestos yarn top jacket is reinforced with Inconel wire. Core consists of long fibre asbestos and flake graphite.

Available in Spools or in Die-Formed Rings. Rings available with either square cross section or with special bevels for concave-convex nest sets.

Get full information on Style 177AI Packing now. Request catalog describing the full line of "John Crane" Packings.

CRANE PACKING CO., 6430 OAKTON STREET
MORTON GROVE, ILLINOIS (Chicago Suburb)
In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS

More TECHNICAL BRIEFS

Begins on page 162

peat and oil from shale are considerable though they are not particularly suitable for exploitation from an economic point of view. Uranium is also found in large quantities, measured in absolute figures, but the content of the rock-bearing material is low.

The water power resources are relatively extensive and their exploitation is taking place at a rapid rate, with consumption rising continually. The time is rapidly approaching when an increasing demand for electric energy, also on a large scale, must be met by some means other than water power, and here power produced by fuel is in question. In this connection interest is directed both towards the peat bogs and to atomic power. The hopes expressed at present, regarding a solution of the future electric power problem, are primarily based on the role atomic power is likely to play in the production of electric energy. *WPC paper No. 29A4.*

The energy resources of the Republic of Ireland. And power developments up to 1955. *By The Irish National Committee.*

The energy resources of Ireland are summarized in this paper as consisting of a small amount of coal, a limited amount of water power, and a substantial amount of peat. The coal is mostly anthracite, and the workable reserves are about 19 million tons. The main fuel reserve is in the peat bogs which cover an area of 3 million acres. The Irish Peat Committee of the Fuel Research Board estimated that the Irish bogs contain between 3100 million and 3500 million tons of anhydrous peat. The estimate was for all Ireland, but the great bulk of the deposits is in the Republic where some 3½ million tons of peat are harvested and burned every year.

The Peat Board is producing one million tons per annum of machine peat, for electricity generation and for general use. The Electricity Supply Board has two peat-burning stations in commission, with an installed capacity of 65,000 kw, and has planned ten further peat stations, aggregating 240,000 kw.

There is also available in Ireland water power, which is estimated as capable of giving a useful output of 900 million to 1200 kw hr per annum. Water power has been utilized by the Electricity Supply Board on three principal rivers—the Shannon, the Erne,

Directions for ordering papers on page 222

MARLEY IS STILL TESTING TOWERS

Here are the current results—a consecutive list of ALL acceptance tests conducted by Marley during 1956 on Cross-Flow industrial towers. Although towers tested were of many sizes and capacities, operating under varying conditions and in various parts of the country, there is one "common denominator" in all the tests—the positive performance of Marley cooling towers. Better than words, better even than written guarantees, these tests are your assurance of complete performance satisfaction when you purchase a Marley cooling tower.

The Marley Company has long pioneered the policy of "test your tower," for we believe that every purchaser is entitled—if not obligated—to know the performance of his tower in exact and authoritative terms. We also believe that every prospective purchaser is entitled to know the performance record of Marley towers, and for this reason have consistently published the results of Marley's own tower-testing program.

If you'd like to know the Marley method of measuring performance of cooling towers, regardless of make or vintage, we invite you to write for our technical publication, "TEST YOUR TOWER."

TEST NO.	TYPE OF SERVICE AND LOCATION	SPECIFIED CONDITIONS				TEST RESULTS	
		Gallons Per Minute	Hot Water Temp.	Cold Water Temp.	Wet Bulb Temp.	Degrees Cold Water Temp.	Percent Capacity
1	Generating Station—North Central	49,200	100.8°	85°	74°	+.26°	+2.3%
2	Generating Station—Southwest	28,000	99.5°	83°	74°	+.15°	+1.5%
3	Chemical Plant—East Coast	33,000	105°	86°	81°	+.43°	+12.7%
4	Generating Station—Mid-West	62,400	107.5°	90°	76°	+.02°	+.13%
★5	Petrochemical Plant—Mid-West	10,000	105°	83°	76°	—.25°	—2.14%
6	Petroleum Refinery—Mid-West	8,500	120°	85°	76°	+.15°	+1.35%
7	Generating Station—Mid-West	26,000	110°	91°	75°	+.70°	+3.4%
★8	Petroleum Refinery—Gulf Coast	21,000	113°	90°	80°	—.45°	—2.85%
9	Petrochemical Plant—Gulf Coast	6,000	105°	85°	80°	+.06°	+.69%
10	Petrochemical Plant—East Central	21,000	120°	85°	73°	—.2°	—1.5%
11	Generating Station—Southwest	38,700	93°	78.5°	65°	—.4°	—2.15%
★12	Generating Station—North Central	7,180	101°	87°	74°	+.1°	+.77%
13	Generating Station—East Coast	26,400	96°	86°	79°	+.30°	+4.17%
14	Petroleum Refinery—Mid-West	8,000	120°	84°	74°	+.70°	+6.4%

★ Tested in accordance with Cooling Tower Institute test procedure ATP-105 and observed by CTI representative.

FOR YOUR FREE COPY, MARK AND MAIL THE COUPON TODAY

MARLEY®

The Marley Company

Kansas City, Missouri

Technical Services Dept., 224
The Marley Company
222 W. Gregory Blvd.
Kansas City, Mo.

Please send me a copy of your brochure, "TEST YOUR TOWER."

Name.....

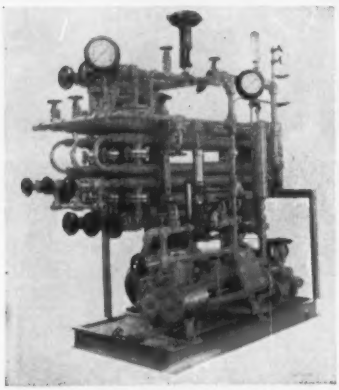
Firm.....

Address.....

City..... State.....

LOCKETT FUEL OIL PUMPING AND HEATING SETS

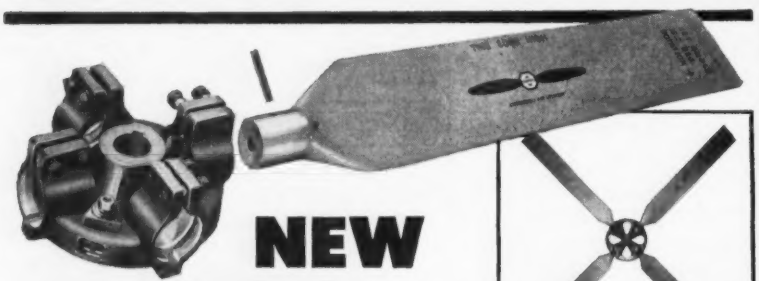
Custom Built



A composite Pump and Heater Set, consisting of one Worthington Steam-Driven Duplex Pump and one Electric-Driven Rotary Pump, with Griscom-Russell Twin G-Fin Heaters mounted above the pumps. Complete with pressure and temperature controls. Fabricated to Consulting Engineer's Specifications. Capacity: 10 GPM of bunker C fuel oil against 175 PSI. Steam pressure 250 PSI.

For more than a half-century, Lockett has been supplying standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Various types of Pumps are available: Turbine or Motor-Driven Rotary Pumps, Electric-Driven Rotary Pumps, and Duplex Steam Pumps, in any combination. Units can be furnished for any capacity or pressure desired; complete with Strainers, Pressure and Temperature Controls, and Instruments. Each pump is suitable for the full rated capacity of the Unit; one pump and one heater are spares. Engineered to your requirements. Completely assembled and shop-tested. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS • HOUSTON • DALLAS



NEW Metal Blade Aeromaster* Fan

AEROMASTER fans 54″ to 22′ for cooling towers and radiator-type coolers.

Lasts Longer • Costs Less

Efficiency . . . economy . . . durability—three important standards—are yours in the AEROMASTER fan.

AEROMASTER fans are efficient because they embody advanced aerodynamic principles. True airfoil blade sections give maximum air delivery.

AEROMASTER fans are economical because adjustable pitch angle of the blade permits a flexibility of setting which enables you to decrease fan load to an accurate minimum horse-power requirement. Design features reduce labor and installation costs.

AEROMASTER fans are durable because they are made from corrosion resisting, silicon-magnesium, aluminum alloys with high tensile strength, fine grain structure and increased endurance limit.

For more details write to KOPPERS COMPANY, INC., Aeromaster Fan Dept., 2605 Scott Street, Baltimore 3, Md.

*Koppers Trademark

KOPPERS

Aeromaster Fans

Engineered Products Sold with *Service*

More TECHNICAL BRIEFS

Begins on page 162

and the Liffey, the plant installed aggregating 188,000 kw. Two other rivers are also being developed—the Lee, and the Clady. *WPC paper No. 17A2.*

Power development in India — some problems. *By M S Thacker, Council of Scientific and Industrial Research, Government of India.*

This paper considers the power situation in India with special reference to the development of electric power, the distribution of power resources and their present and potential capacity, and the power needs of established industries and industrial projects.

The per capita production of electric power, plant capacity and power generated per sq mile for India are all very low compared with other countries, and indicate the magnitude of the development that would be necessary. The main energy sources at present are coal and hydro power. The progress of public electric power installations is shown. The generating capacity is expected to double itself during the period of the country's second 5-year plan.

Over 50% of the power supply comes from thermal stations using coal. Coal distribution is uneven and its utilization therefore not economic everywhere. Resources are also not unlimited, and therefore the recent discovery of extensive lignite deposits is a bright feature. The efficiency of thermal stations is very low at present, but is steadily improving with the new installations.

India's hydroelectric potential is large, but as yet hardly tapped. The central and state governments are inevitably the sponsors of hydroelectric projects in view of the heavy initial investments involved. Many multipurpose projects are already under execution, and the progress of hydroelectric development is indicated. *WPC paper No. 223A38.*

Brief review of energy development in India. *By M S Thacker, Council of Scientific and Industrial Research, Government of India.*

This paper reviews the power resources of India, which are mainly coal, oil, and hydro power at present. Coal accounts for nearly two-thirds of the total electrical power generating capacity; to conserve coal resources, the formulation of a national coal police is necessary. Extensive deposits of lignite have been located in Madras State. The hydroelectric potential de-

Directions for ordering papers on page 222

Values You Can't Specify

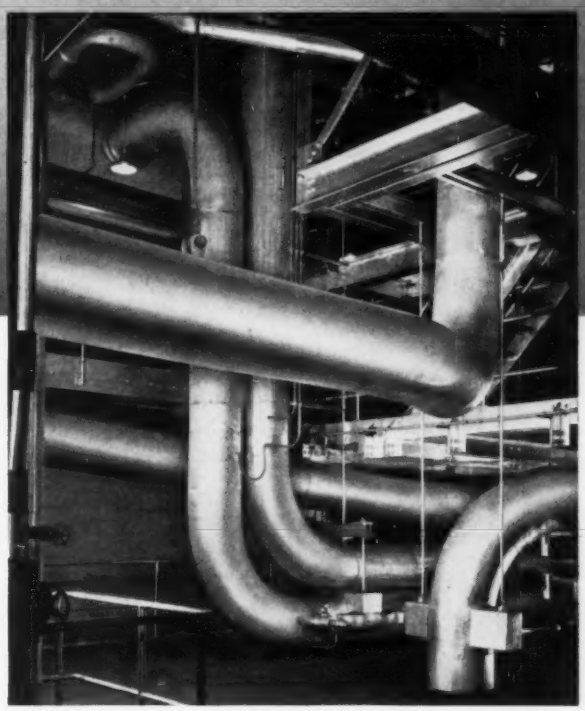
You Get Them in MIDWEST PIPING

In the fabrication and erection of every high pressure and/or high temperature piping installation, there are intangibles important to the success of the job . . . things that cannot be spelled out in the specifications but are essential to getting superior piping at an economical price.

Important among these is the experience of the fabricating and construction organization . . . experience on all kinds of projects so that the possibilities and limitations of all piping materials are well understood. Midwest has fabricated and erected the piping on many critical jobs . . . including numerous atomic energy projects and Kyger Creek (the largest steam power plant ever handled completely by one piping contractor).

Another is a questioning attitude . . . a frame of mind that habitually asks (before the job is placed in the shop for fabrication): "Have the pre-fabricated sub-assemblies been so planned that the field work is minimized and simplified as much as possible?" Highly skilled Midwest piping engineers carefully analyze every job with this question in mind.

For power plant or process, the customer gets the most for his money when he buys Midwest Piping.



Main steam piping at Kyger Creek Plant which has a capacity of 1,075,000 kw and is the largest power plant piping contract (combining fabrication and erection) ever performed by a single contractor.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

ASHEVILLE (BOX 446, SKYLAND, N. C.) • BOSTON 27—426 FIRST ST.
CHICAGO 3—79 WEST MONROE ST. • CLEVELAND 14—616 ST. CLAIR AVE.
HOUSTON 2—1213 CAPITOL AVE. • LOS ANGELES 33—520 ANDERSON ST.
MIAMI 34—2103 LE JEUNE RD. • NEW YORK 7—50 CHURCH ST.
ONEIDA, N.Y.—282 NORTH MAIN ST. • SAN FRANCISCO 11—420 MARKET ST.

7670

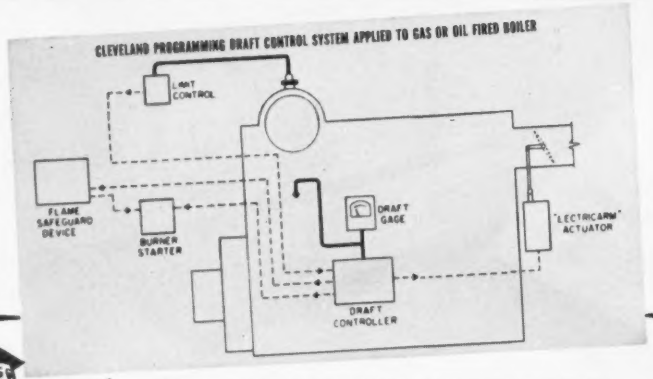
MIDWEST PIPING FABRICATION AND CONSTRUCTION

Offer you many advantages

Free DATA ON COMBUSTION AUTOMATION SYSTEM

NO. 2 OF A SERIES

CONTROLS



WRITE TODAY for FREE Manual (No. 2) plus "Control Fundamentals" booklet.

HOW TO PLAN AND SPECIFY THE CONTROL SYSTEM BEST FOR YOU

Schematically diagrammed and easy to understand, this FREE Manual is No. 2 of a series designed to enable you to solve your combustion control problems. Tells how to select the proper controls to automatically maintain top combustion efficiency and safety under all firing and load conditions.

CLEVELAND CONTROLS
1111 Brookpark Rd. • Cleveland 9, Ohio
"100 Field Engineers To Serve You"

COMBUSTION CONTROL SYSTEMS
INDICATING INSTRUMENTS
AIR SAFETY SWITCHES
PANEL CONTROL CABINETS

For Fast Service

when you need

BOILER TUBES *(bent or straight)*

call on these representatives

CLEVELAND	Boiler Tube Co. of America	*Yellowstone 2-6105*
CHICAGO	Boiler Tube Co. of America	*State 2-7955*
PHILADELPHIA	Raphael Paul	*Lombard 3-7700*
LOS ANGELES	Fred S. Renauld & Co.	*Pleasant 2-6181*
TAMPA	John D. Homan	*Tampa 65-7211*
ATLANTA	E. W. Harbour (College Park)	*Fairfax 1374*
ROANOKE	J. J. Bower	*Roanoke 6-3474*
HAVANA, CUBA	Wm. P. Bryant	*M-9284*
SAN JUAN, P.R.	F. A. Ortez & Co.	*2-4934*

BOILER TUBE CO. OF AMERICA
McKEES ROCKS, PA. (Pittsburgh District) *Federal 1-7750*

3

More TECHNICAL BRIEFS

Begins on page 162

veloped so far is only a very small percentage of the estimated total, and further development is chiefly dependent on availability of capital. Mineral oil resources are limited, although recently there has been indication of oil in new areas.

Prospects of exploiting unconventional sources of power are bright. India has the largest thorium deposits in the world, and known deposits of uranium ore are already being worked. A plan for atomic power stations has been formulated. Attempts will be made to use low-grade fuels and farm wastes for power generation; development work on gas turbines, in this context, is proceeding. Prospects for wind power utilization are good and a project has been drawn up to set up large numbers of small and medium-sized units. Harnessing of solar energy is a difficult matter, but experimental work is being carried out. *WPC paper No. 204A36.*

The Middle East as a factor in the pattern of oil supply. *By P T Cox, British Petroleum Co, Ltd.*

The changing patterns of the world's supply and consumption of petroleum in the past are briefly reviewed and it is concluded that the comparatively recent emergence of the Middle East as a major contributor to the world's oil supply has been primarily the outcome of its geographical position in relation to areas of active industrial development.

The geological setting of the Middle East is outlined as a background for consideration of the crude oil reserves of the region and certain oil-field characteristics peculiar to it. The Middle East has proved reserves which amount to some three-fifths of those of the whole world and it is considered probable that the region's ultimate crude oil production will amount to about double the volume of oil already discovered in it. No other area of the world of comparable extent is expected to yield oil on this scale. Besides the great total volume of Middle East crude oil, the region is unique in possessing so many fields of great size and in the small amount of drilling that has been necessary to find and develop its reserves.

Owing to the predominance of the quantity of crude oil proved in the Middle East compared with that found, or likely to be found, elsewhere, it is considered that other factors will be

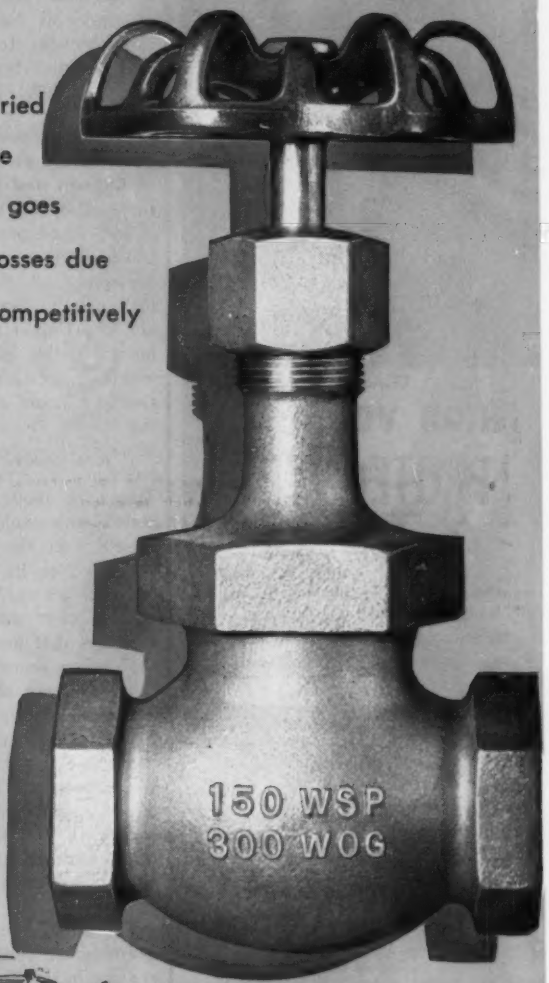
Directions for ordering papers on page 222

END THOSE VALVE TROUBLES . . . NOW!

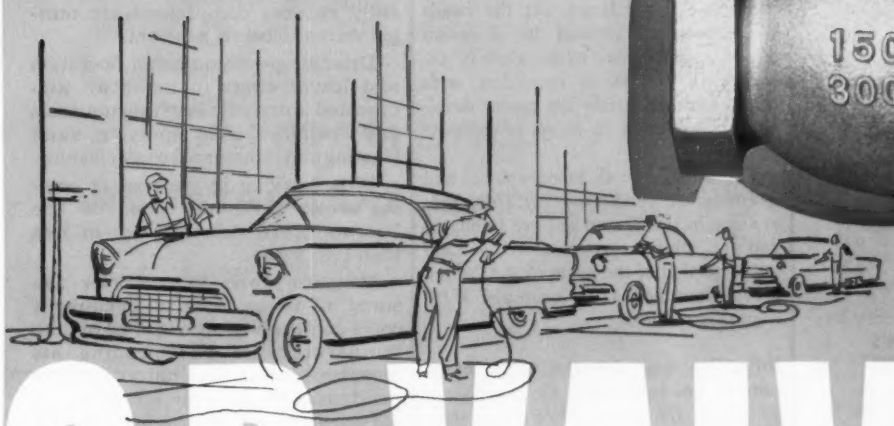
Are bronze valves a source of trouble in your maintenance program? Then you haven't tried O-B valves. Put them in your plant. Watch the maintenance job get easier as O-B quality goes to work. Notice the drop in production time losses due to valve troubles. O-B bronze valves are competitively priced. Ask your distributor about them.

Ohio Brass

MANSFIELD OHIO, U. S. A.



4615-V



O-B VALVES

CHARCO

HIGH VOLTAGE PROTECTIVE EQUIPMENT

Charleston Rubber Company leads the field in manufacture of superior protective products for linemen and high voltage workers

CHARCO

FLEX-SAF

LINEMEN RUBBER GLOVES

AND

FLEX-FIT

LINEMEN RUBBER SLEEVES

CHARCO Flex-Saf Gloves and Flex-Fit Sleeves are made of the same top quality rubber. Both well exceed ASTM specifications, and also the most critical inspection and testing standards of the industry.

WRITE FOR

CATALOG OF LINEMEN'S PROTECTIVE EQUIPMENT

This new illustrated catalog, for use in public utility and industrial electrical fields, illustrates many products and gives concise instructions on proper care and use

GLOVE CARE POSTER

18" x 22" Poster Shows How To Properly Care For and Use Linemen's Gloves and Sleeves

Please specify which you desire

CHARLESTON RUBBER CO.

CHARLESTON CHARCO SERVICE FOR SAFETY RUBBER CO.

46 Stark Industrial Park

CHARLESTON, S.C.

More TECHNICAL BRIEFS

Begins on page 162

of only subordinate significance in determining the future patterns of oil supply and that the Middle East will become the principal world supplier of crude oil during the next two or three decades. It is expected to retain that position for a long time. *WPC paper No. 199A35.*

Problems of development of international rivers on the Pacific Watershed of Canada and the United States. *By General A G I McNaughton, International Joint Commission.*

The northern portion of the Pacific Watershed of North America divides between the jurisdictions of Canada and the United States. In this region many of the more important rivers, including the Columbia and the Yukon, rise in Canada and in their course to the Pacific Ocean flow across the international boundary into United States territory. By the Boundary Waters Treaty of 1909 the riparian state is vested with exclusive jurisdiction and control over the use and diversion of all waters on its own side of the line. It is subject only, should injury result on the other side, to the same legal remedies that would be accorded as if such injury occurred in the place in the country where the diversion or other interference occurs.

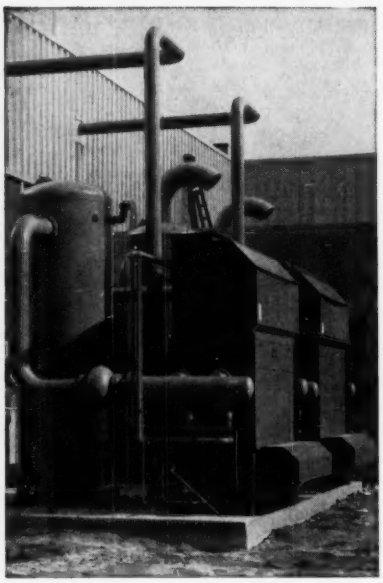
Not only are the flows of the rivers in question very large, but the heads which may be created by diversion amount, in several cases already investigated, to 2000 or more feet, with consequent potentials for power development measured in terms of millions of kilowatts.

The jurisdictional, topographical and hydrological conditions and problems at issue in the Watershed are indicated and the solution proposed in the Canadian portion of the basin of the Columbia is described as an example. *WPC paper No. 18204.*

Utilization and potential resources of natural gas in Mexico. *By Ing Luis F de Anda, Geothermic Power Commission.*

The utilization of natural gas in Mexico started only a few years ago. There are three main producing zones, where prospecting continues, although for the time being part of the production has not yet found a sufficient market. The country has gas deposits estimated at 74,120 million cu meters in 1952. The total length of gas pipelines actually in service is at present

Directions for ordering papers on page 222



This Niagara Aero After Cooler also cools compressor jacket and intercooler water.

COMPRESSED AIR

- **Lower in Cost**
- **Drier and Cooler**

THE NIAGARA *AERO* AFTER COOLER offers a completely self-contained method replacing both shell-and-tube cooler and cooling tower. It is independent of a large supply of cooling water and consistently reduces compressed air temperatures to below ambient.

Drier air gives you better operation and lower costs in using all air-operated automatic instruments, tools and machines, paint spraying, sand blasting and moisture-free air cleaning.

Direct saving in the cost of cooling water saves the price of the Niagara *Aero* After Cooler in less than two years.

Niagara *Aero* After Cooler assures all these benefits because it cools compressed air or gas below the temperature of surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air through a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter, proven in service on the largest plant utility systems.

Write for Bulletin No. 130

NIAGARA BLOWER COMPANY

Dept. P-5, 405 Lexington Ave.

NEW YORK 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada

Rugged insulation finish protects and color codes lines, tanks, and vessels

You can be sure of long-lasting protection for insulation, both indoors and outdoors, with Armstrong Insulcolor. In addition, Insulcolor neatly color codes your lines, tanks, vessels, and ducts. Available in seven colors, plus a clean white, Insulcolor is quickly applied by conventional brush or spray methods. It will withstand all temperatures up to 160° F. without cracking, crazing, or peeling. Maintenance is easy; dirt washes readily from Insulcolor's smooth, tough plastic surface.

Insulcolor is one of many quality products in the Armstrong line of industrial insulations. Armstrong also offers you a complete contracting service, geared to install these products economically and efficiently.

For full details on Insulcolor or any other Armstrong insulations, send for free booklets. Check the ones you want on the coupon below.

Armstrong

INDUSTRIAL INSULATIONS

for temperatures from – 300° F. to + 3000° F.

☐ Armstrong Insulcolor®, Weatherproof Coating in Eight Colors

☐ Kaylo-20 Pipe Covering (data sheet)

☐ Armstrong Armaglas** Insulations for Piping, Tanks, and Vessels

☐ Armstrong Armatemp† Insulating Cements

Armstrong Cork Company
2505 Riggs Ave.
Lancaster, Penna.

Please send me the free booklets checked. ☐

Please have an Armstrong representative call. ☐

Name .....

Position .....

Company .....

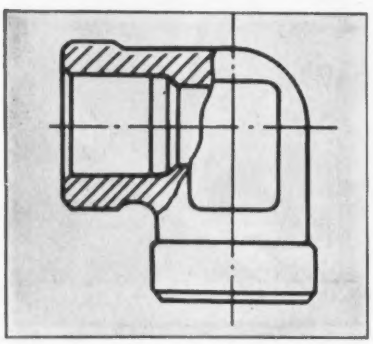
Address .....

City ..... Zone .... State .....

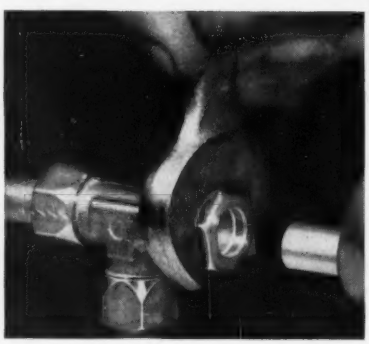
** T.M. Armstrong Cork Co. Manufactured by Owens-Corning Fiberglas Corp.
† Trade-Mark

Simply insert tube, then weld! No wonder Parker Weld-lok *tube* fittings are so easy to use . . . by anyone, anywhere. You don't need special gripping fixtures. A tapered socket aligns and holds the tube. The permanently welded joint is unaffected by vibration, shock, or thermal distortion. Especially good under extreme temperature or corrosion conditions.

Use Parker Weld-lok fittings for tubing ¼ through 2" O.D.



Cutaway view of Weld-lok *tube* fitting shows detail of the simple design. All commonly used connectors and body shapes are offered in steel and stainless steel. Send for Catalog 4370 listing shapes, sizes.



Intru-lok fittings are easy to use for copper instrumentation lines. Just insert the tube, then tighten the nut with a regular wrench . . . for a leakproof vibration-proof joint. Also used with plastic tubing. Send for Catalog 4324.

TUBE AND HOSE FITTINGS DIVISION
Section 424-X
The Parker Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio

Parker
Hydraulic and fluid system components

More TECHNICAL BRIEFS

Begins on page 162

1116 km; great attention is given to the completion of an extended distribution system, but consumers have not been found as yet among the big industries. *WPC paper No. 160A26.*

Hydraulic resources in Mexico. *By Ing Luis F de Anda, Geothermic Power Commission.*

According to various estimates of Mexico's hydropower potential, the total usable capacity amounts to from 6,374,000 hp to 28.5 million hp. However, only a very small percentage of this capacity has been developed. Since there is no snow in the country, rain is the main source of hydraulic energy. The mean annual rainfall has been assessed at approximately 773 mm (as an average for all of the four climatic zones in the country). Only 12% runs off, 33% filters into the ground, while 55% evaporates. The paper winds up with a list of locations suitable for the erection of hydropower plants. *WPC paper No. 161A27.*

Nuclear Energy

The methods of using fuels in a nuclear power program. *By J V Dunworth, U. K. Atomic Energy Authority.*

The United Kingdom is building natural uranium gas-cooled graphite-moderated reactors and in addition has built a diffusion plant. It is now able to consider the many types of reactor which are possible once separated uranium 235 and plutonium are available.

Future high output reactor developments seem likely to be associated with three distinct types of system. 1. A thermal or near-thermal heterogeneous reactor in which a long-life fuel is used. It seems likely that the chemical and metallurgical considerations as well as nuclear ones will favor the thorium-uranium 233 fuel cycle and that such a reactor will be about self-maintaining in fissile material. Initially, some of the reactors may well operate on a plutonium-uranium 238 fuel cycle. 2. A homogeneous type of reactor that seems likely to operate only on the thorium-uranium 233 fuel cycle and the aqueous system has a long lead at present. 3. The fast or slightly moderated fast reactor which can lead to a very high gain factor using the plutonium-uranium fuel cycle, and rather lower ones using the thorium-uranium 233 cycle. In both cases some sacrifice of part or all of the gain factor is likely to ease engineering and processing problems

Directions for ordering papers on page 222

ANOTHER CATERPILLAR FIRST!

CERTIFIED POWER

FOR CAT* DIESEL ENGINES

CATERPILLAR TRACTOR CO.

ENGINE POWER CERTIFICATION

This is to certify that the Diesel Engine herein described has been engineered, manufactured and tested in accordance with rigid Caterpillar Standards. The materials and workmanship incorporated into this engine give it the inherent capacity for satisfactory performance when applied in accordance with the power ratings established and recommended by this company. The MAXIMUM OUTPUT capacity of this standard production engine is 200 H.P. @ 2000 R.P.M. equipped with: air cleaner, water pump, lubricating oil pump, fuel pump, and standard intake and exhaust manifolds.

I certify that B. L. Henson, Supervisor of Diesel Engine Test, Caterpillar Tractor Co., [illegible] and I affix my [illegible] Certification and I affix my [illegible] Seal this 27 [illegible]

[illegible] Exp 11/30/58

B. L. Henson
Supervisor Diesel Engine Test
Caterpillar Tractor Co.
Peoria, Illinois

Caterpillar Model D326 Industrial was manufactured and shipped as follows: Engine Serial No. 39B1018 Shipping Date February 11, 1957

Power Setting 152 H.P. @ 1600 R.P.M. Intermittent Power Rating

[illegible]nts

Radiator & Fan
Ether Starting Aid
32V Charging Generator
Governor Control
Tachometer Drive
Muffler
Heater Connections
Remote Shut-off

POWER RATINGS

MAXIMUM OUTPUT is the horsepower capacity of the engine, a measure of the maximum power, ± 5%, that can be developed for five minutes without drop in speed.

INTERMITTENT HORSEPOWER is a rating for use in variable load applications such as excavators, hoists, and standby power units, where the duration of sustained full power output is one hour or less, with the average output not over 80% of Intermittent Horsepower.

RATED HORSEPOWER is a rating for use in applications such as planing mills, hammer mills, and rock crushers where the duration of sustained full power output is 12 hours or less.

CONTINUOUS HORSEPOWER is a rating for use in applications such as work boats and pumps where the duration of sustained full power output is 24 hours per day, day in—day out.

Horsepower figures are established in accordance with rigid Caterpillar standards. All ratings, corrected to sea level barometric pressure (29.92 in. Hg.) and standard temperature (60°F), apply to a production engine including air cleaner, water pump, lubricating oil pump, fuel pump and standard intake and exhaust manifolds. The above ratings are based on British and American B.H.P.

Printed in U.S.A.

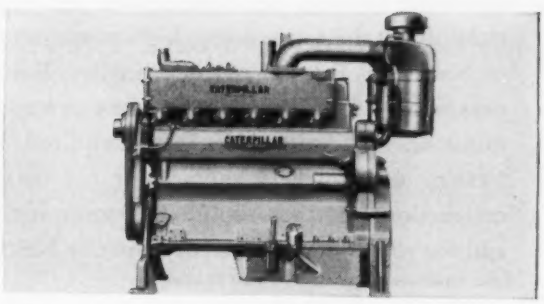
FORM NO. 515-32503

In a quarter century of diesel leadership Caterpillar Engines have achieved a reputation for *honestly rated power*. Owners have found that they can depend on a Cat Diesel to deliver the power promised.

Now, to back this reputation, Caterpillar becomes the *first* manufacturer to issue a certificate showing the horsepower capabilities of the engine. This certificate is signed by Caterpillar Tractor Co. and certified by a notary public.

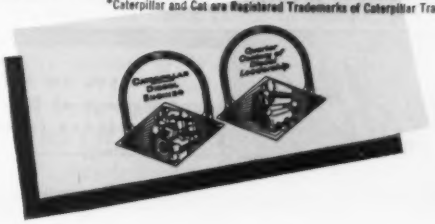
You have a right to demand *certified power* when you invest in an engine. You get it when you buy from your Caterpillar Dealer. Let him show you the certified power plant that fits your needs.

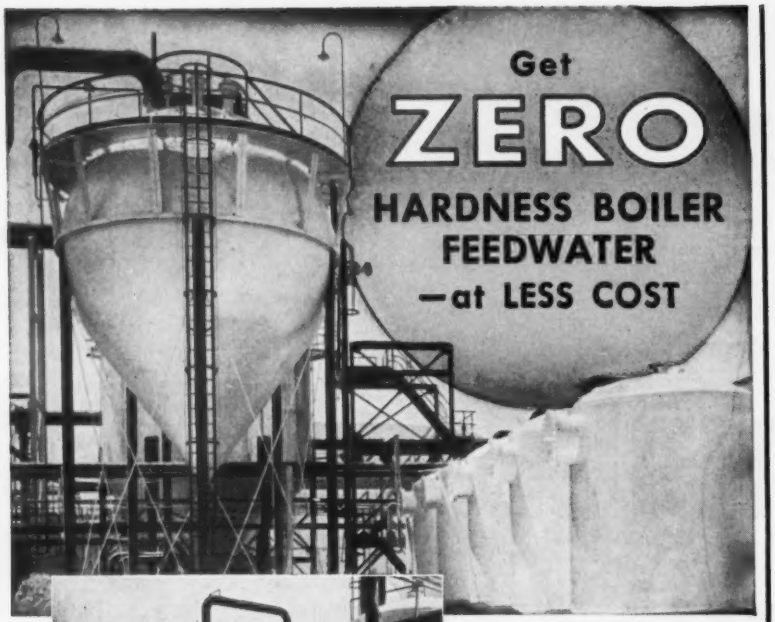
Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

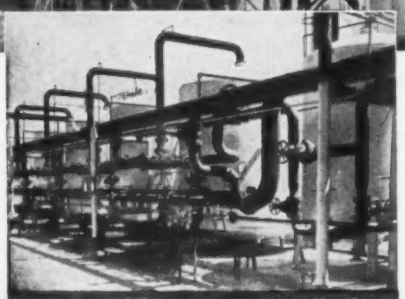


CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.







Top photo shows new outdoor hot lime-zeolite softener installation in a Southern refinery. Five Nalcite HCR ion exchange units (lower photo) have output of 420,000 gallons of zero hardness water between regenerations.

with
Nalcite® (DOWEX*) HCR
HOT LIME
ZEOLITE
TREATMENT

Start with the simplicity of operation . . . add the low operating costs of hot lime-zeolite softening . . . all made possible by the outstanding high-temperature performance of Nalcite HCR in the zeolite softeners. Results: Zero hardness water, from virtually any raw water source, with a minimum of testing and control required. See your water treating equipment manufacturer for details on new or conversion hot lime-zeolite treatment for your plant . . . and for top softener efficiency, specify Nalcite HCR.

*Reg. Trademark of The Dow Chemical Company

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

Nalco® PRODUCTS

When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

More TECHNICAL BRIEFS

Begins on page 162

and result in a more economic system. This could well be the method of emergence of an intermediate system. In this case, the indications are that the fuel cycle will be thorium-uranium 233 once again. *WPC paper No. 210J15.*

Standards

Slotted and recessed head wood screws *—ASA B18.6.1-1956.*

Scheme for identificaton of piping systems—*ASA A13.1-1956.*

Ring-joint gaskets and grooves for steel pipe flanges—*ASA B16.20-1956.*

20 degree involute fine-pitch system *—AGMA 273.04 and ASA B6.7-1956.*

Inspection of fine-pitch gears—*AGMA 236.04 and ASA B6.11-1956.*

All the above Standards may be purchased from ASME, 29 W 39th St, New York 18, N. Y.

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

World Power Conference, 5th meeting, identified by initials WPC. Information as to availability obtainable from Oesterreichisches Nationalkomitee der Weltkraftkonferenz, Vienna I, Schwarzenbergplatz 1, Austria.

Westinghouse Electric Corp has been awarded the contract to develop the nuclear reactor for Yankee Atomic Electric Co's atomic electric power generating station to be built near Rowe, Mass. Plant will produce 134,000 kw using a pressurized water reactor.

Plans to build a nuclear-fuel facility at Hicksville, N. Y., have been announced by Sylvania-Corning Nuclear Corp. Fuel elements produced will be used in reactors designed for research and electric power generation.

ACCO
for Better
Values

R-P&C VALVES

DESIGNED FOR DEPENDABILITY

BAR STOCK VALVES FOR CLOSE CONTROL, ESPECIALLY SUITED FOR CLOSE-COUPLED INSTALLATIONS

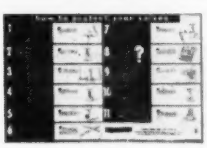
• rated for pressures up to 10,000 PSI •

• The bar stock valve, designed originally by R-P&C engineers, is really a versatile performer. First developed for instrument use, bar stock valves have proven to be the answer to valve problems of many different kinds. Designed for close control, they are ideal for throttling service. Their compactness makes them the natural choice for crowded locations such as panel boards. Economically priced, they serve in many applications as general purpose valves. And they are built in a wide variety of materials—can withstand extremely high temperatures and pressures.

For example, the **Fig. 1040-A Valve** shown here, made from carbon steel, is rated for 10,000 psi at 150°F. Each of these valves is individually tested at 15,000 psi before it leaves the factory.

R-P&C's complete line of bar stock valves includes constructions in 12-14 chromium stainless steel, 18-8 molybdenum stainless steel and bronze. Sizes range from ⅛" to 1" in globe and angle styles with female ends, male and female ends, or male union ends. For extremely severe throttling services, R-P&C bar stocks can be supplied with stellite discs for extra abrasion resistance.

Your R-P&C distributor carries not only a complete line of bar stock valves but also a wide selection of gate, globe, angle and check valves in bronze, iron, and cast and forged steel. You will find the answer to your valve problem in his selection.



FREE WALL CHART
"How to Protect Your Valves"
Installation pointers, operating tips, clues to longer valve life. They are all on this 22" x 17" wall chart. Write for your free copy.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

ACCO

Choose A Standard SCAM ALARM for All Your MONITORING

Typical Scam DE-LINE annunciator cabinet showing plug-in and backlighted nameplate unit. Cabinets available in four standard widths, 3-5-7 or 11 alarm points wide, any number high.

Even the most advanced automatic system needs the reliable monitoring that only good annunciators offer. And of those available only Scam gives you the benefit of broad standardization and interchangeability to cover the most specialized requirements. For instance, the DE-LINE annunciator can provide, in one standard cabinet...

1. **Backlighted nameplates or bullseye indication.**
2. **Sequential alarm identification.**
3. **Easy adaption for use with Scam DU-ALL annunciators for HI-LO indication.**
4. **Optional ringback or manual reset functions by the operation of a slide switch.**

There are many other standard features of DE-LINE annunciators that are usually provided only on special order – features that make them the most versatile available, capable of "growing" with any control system. Write for literature or call any representative in the cities listed below.

THE SCAM INSTRUMENT CORP.

Chicago 18, Illinois
Phone GR 7-7850

SALES REPRESENTATIVES:
Atlanta • Boston • Buffalo • Chicago
Cincinnati • Cleveland • Dallas • Detroit
Houston • Indianapolis • Kansas City
Los Angeles • Louisville • New York
Philadelphia • Pittsburgh • Portland
St. Louis • San Francisco • Seattle • Tulsa
Toronto and Vancouver, Canada

My biggest boner...

I was chief in a neat little steam plan before World War I. Everything was spit-and-polish, from the highly polished floor to the Fitchburg steam engine. That plant was such a honey that I did my best to keep it sparkling.

We bought our lubricating oil in drum lots, then transferred it to the engine-room tank with a hand pump. But that was a slow messy job so I dreamt up a very efficient gadget for doing the job quickly and neatly.

My idea was to blowout the drums with compressed air. And all I needed were a few pieces of pipe and fittings to get air into the drums. That brainstorm worked swell.

But one day I got careless and forgot to shut the air valve to my contraption before starting the air compressor. The compressor was outside the engine room, about 100 ft from the oil drum.

As I entered the engine room, after starting the compressor, there was a loud WHOOSH—BANG. You guessed it. My homemade gadget and about ten gallons of oil had taken off for the ceiling, splattering all over my shiny engine room. On its way down, that equipment barely missed hitting the spinning flywheel and the electric generator that was driven by the engine.

Besides a tough clean-up job, my biggest boner was almost my last one.

A H PARKER *Peterborough, N. H.*

REPORTS from the FIELD

Begins on page 160

Their approach to the problem: if you don't have enough good men—raid the competition. Conventions are their happy hunting ground. Visiting engineers are wined, dined and beguiled by tempting salary offers.

This solution is seldom satisfactory to the company or the engineer involved.

A company which indulges in these shenanigans is usually vulnerable. The fabulous starting salaries it offers put a strain on its budget. It has to cut corners somewhere, so raises go by the board. This breeds dissatisfaction in the ranks. Result: many a manager has returned from a convention with several good catches only to find his own office picked clean.

Industry's long range plans are good. As encouragement to young men thinking of an engineering career, many

Use REMA to add years of life to your Belts

REMA is the New and Amazing Self-Vulcanizing Rubber Repair Material

REMA REQUIRES
- NO HEAT
- NO HEAVY EQUIPMENT
- NO CURING TIME DELAY

• REMA is not just another cold patch. REMA is vulcanization by chemical process. The repaired area is sealed with an abrasive resistant cover stock patch. No heat or heavy vulcanizing equipment required. Here's the astonishing advantage—*when repair work is completed belts may be returned to service immediately.*

• REMA seals out moisture, reduces mildew, rot and deterioration — the great enemies of conveyor belts. Your own maintenance man can quickly repair your belt — it doesn't take a skilled belt mechanic to use REMA.

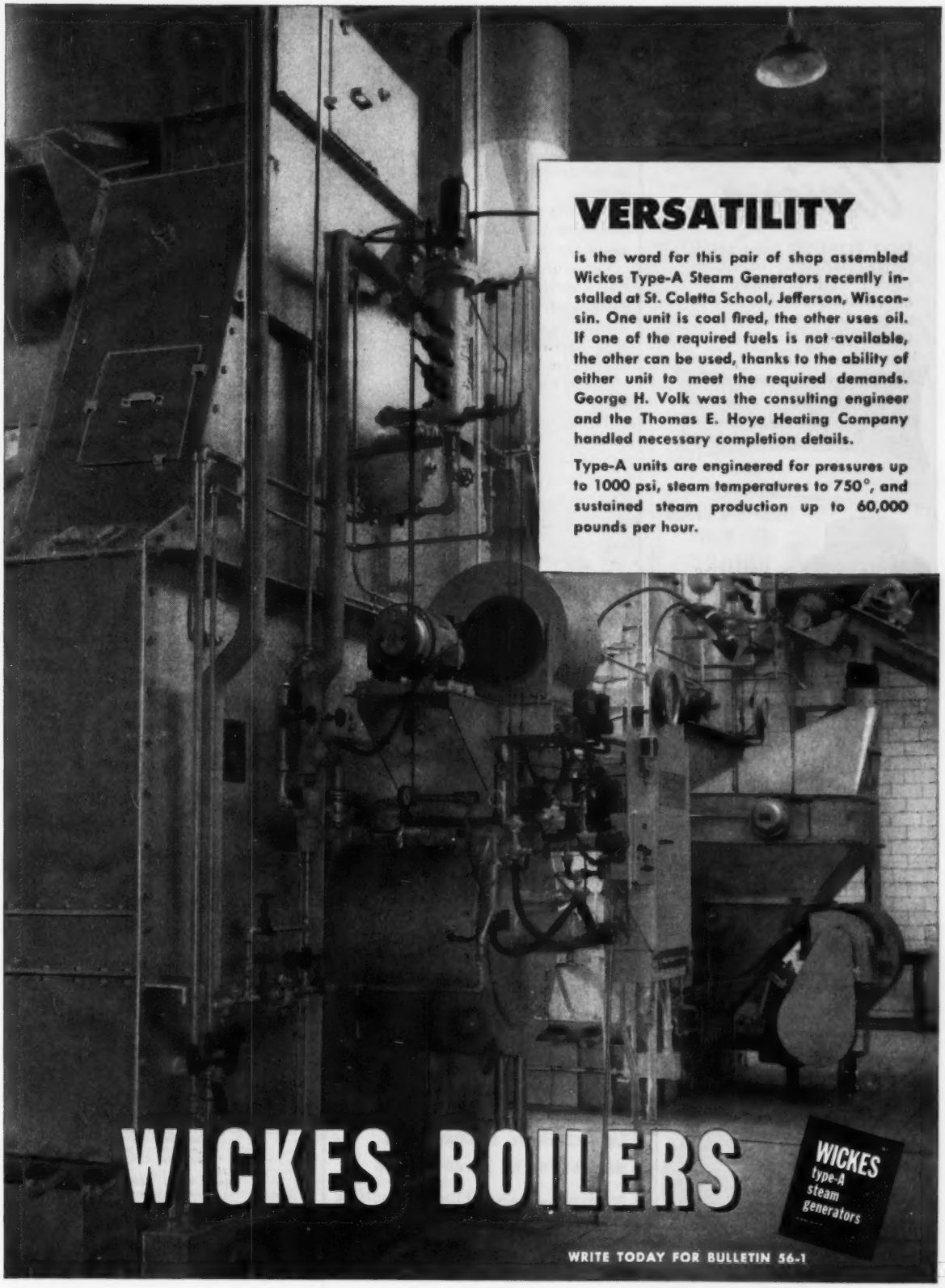
• Used for repair of all types of damaged spots, edge wear and for covering metallic joints. Available in introductory kits or parts separately.

Order from your Flexco-Alligator distributor

Write for Folder No. R4

FLEXIBLE STEEL LACING CO.
4651 Lexington St., Chicago 44, Ill.

REMA SELF-VULCANIZING RUBBER REPAIR MATERIALS


VERSATILITY
is the word for this pair of shop assembled Wickes Type-A Steam Generators recently installed at St. Coletta School, Jefferson, Wisconsin. One unit is coal fired, the other uses oil. If one of the required fuels is not available, the other can be used, thanks to the ability of either unit to meet the required demands. George H. Volk was the consulting engineer and the Thomas E. Hoye Heating Company handled necessary completion details.
Type-A units are engineered for pressures up to 1000 psi, steam temperatures to 750°, and sustained steam production up to 60,000 pounds per hour.
WICKES BOILERS
WICKES type-A steam generators
WRITE TODAY FOR BULLETIN 56-1

THE WICKES BOILER CO., DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D. C. 165

Catawissa
PERFECT SEAL
Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes 1/8" to 3"; 6000-lb. sizes 1/8" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.

WRITE FOR CATALOG 56
showing the complete Catawissa line of Perfect Seal products

CATAWISSA VALVE & FITTINGS COMPANY
206 MILL ST. • CATAWISSA, PA.

REPORTS from the FIELD

Begins on page 160

thousands of dollars have been donated to education through grants and scholarships.

But, says ASME, this is an answer to future problems, not those of the present.

Recently a news release reached us that showed what one industry is doing about the matter.

Concerned over the way technology was outstripping working knowledge, Flick-Reedy Corp, manufacturer of hydraulic equipment, assembled a "college of cylinder knowledge," put it inside a bus and proposed to deliver it, complete with faculty, to plant or school door.

Today, the project has grown to four "colleges." Flick-Reedy plans now to begin stopping at colleges and schools, so technical and science students can have a first-hand glimpse of modern hydraulic applications.

With the aid of more projects like this, engineers feel that industry will solve its most pressing shortages by uncovering its hidden assets.

GE tackles tall order for a 375,000-kva transformer

► A POWER TRANSFORMER large enough to supply the residential needs of a city of 900,000 people is being built by General Electric Co. Rated 375,000 kva, it will be shipped next year to a midwest utility.

The unit is the highest-rated power transformer ever ordered from General Electric, according to officials there. While only slightly larger than the biggest transformer of a decade ago, it will have more than two and a half times as much electrical capacity.

New unit will weigh 1.5 lb per kva. No-load and total losses per kva are less than 90% of those of the older units, says GE. Loss improvement and the 40% reduction in proportional weight is attributed to new design knowledge and improved core steel in addition to the economies of larger size.

Largest liquid sodium pump progressing at Byron-Jackson

► BYRON JACKSON PUMPS is building what is said to be the largest liquid sodium pump in the world. The pump under order to Atomic Power Development Assoc, Inc, will be used as a primary cooling pump for one of the nation's first full scale commercial power plants using nuclear fuel.

Pump is approximately 32 ft high with a 6 ft diameter. Rated at 1000 hp,

JUST OUT

MAINTENANCE ENGINEERING HANDBOOK

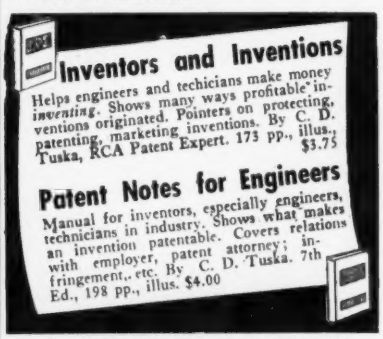
NOW — plant-tested methods for finding new profits through better maintenance! Seventy-five experts give you practical, workable answers to hundreds of problems relating to every *function* of maintenance engineering—in administration and operation; in planning, work scheduling, and cost control; and in the hundreds of details of keeping plant and equipment in top operating shape. **Edited by L. C. Morrow, General Chairman, National Plant Maintenance and Engineering Conferences. 1156 pp., 728 illus., $20.00**

ELECTRICAL SYSTEMS DESIGN

Just Published—Comprehensive, practical manual on design of modern and efficient electrical systems. Covers systems for power, light, heat, and signals and communications—in commercial industrial, institutional, and residential buildings. Step-by-step procedures are shown for planning to meet the electrical power requirements—implementation by equipment and hardware—and incorporating system in physical building dimensions. **By J. F. McPartland and the Editors of Electrical Construction and Maintenance. 140 pp., 8½ x 11, illus., $6.00**

PUMP SELECTION AND APPLICATION

Just Published—Aids engineers in all fields to get more economy and efficiency from pumping installations. Discusses basic types of pumps; problems met in their application. Covers special pumping problems of a number of industries. Step-by-step procedures for analyzing pumping problems, finding most suitable commercial pump for the job, and applying it to the job conditions. **By Tyler G. Hicks, Assoc. Ed., Power. 422 pp., 411 illus., $8.50**


Inventors and Inventions
Helps engineers and techicians make money inventing. Shows many ways profitable inventions originated. Pointers on protecting, patenting, marketing inventions. By C. D. Tuska, RCA Patent Expert. 173 pp., illus., $3.75
Patent Notes for Engineers
Manual for inventors, especially engineers, technicians in industry. Shows what makes an invention patentable. Covers relations with employer, patent attorney; infringement,. etc. By C. D. Tuska. 7th Ed., 198 pp., illus. $4.00

SEE THESE BOOKS 10 DAYS FREE

McGraw-Hill Book Co., Inc. Dept. P-5
327 W. 41st St., N.Y.C. 36

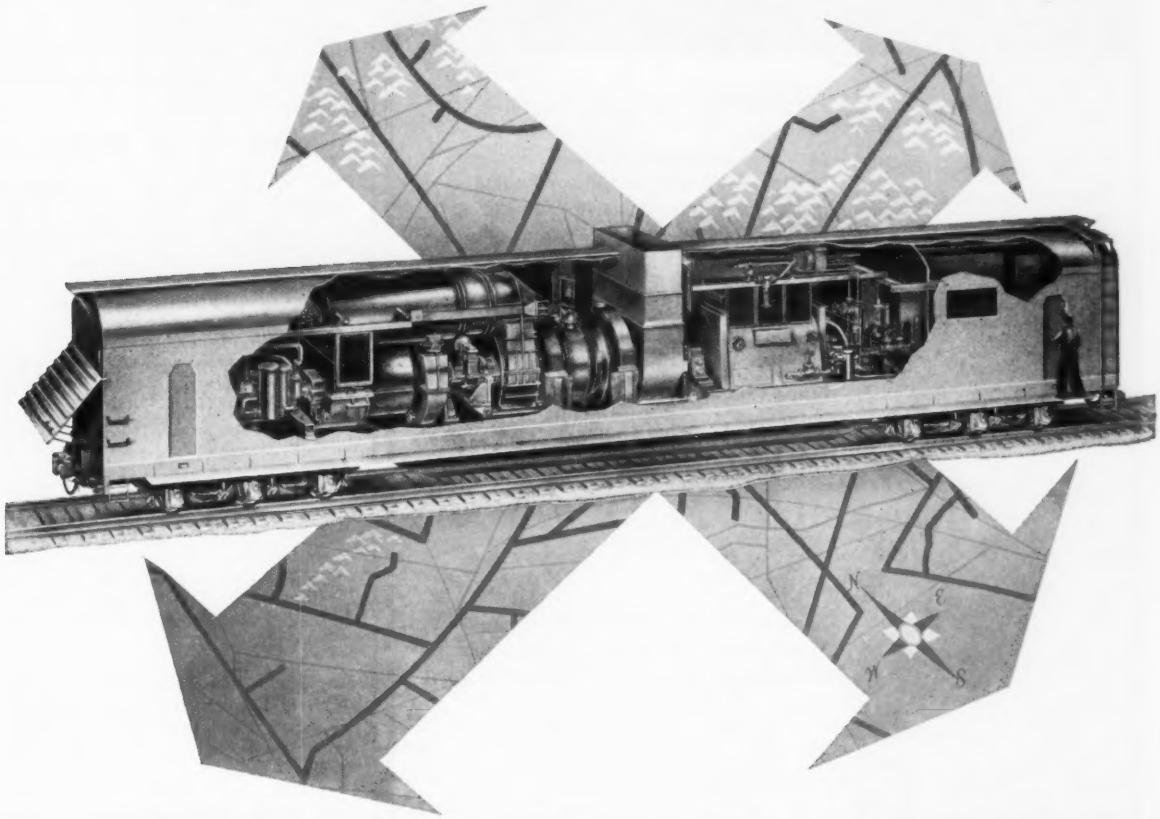
Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privilege.)

- ☐ Morrow—Maint. Engrg. Hdbk, $20.00
- ☐ McPartland—Elect. Systems Design, $6.00
- ☐ Hicks—Pump Select. and Applic., $8.50
- ☐ Tuska—Inventors and Inventions, $3.75
- ☐ Tuska—Patent Notes for Eng., $4.00

(PRINT)

Name .....
Address .....
City ..... Zone ..... State .....
Company .....
Position .....
For price and terms outside U. S., write McGraw-Hill Int'l., N.Y.C. P-5

KILOWATTS



...where and when you need them

Heavy temporary electrical loads out at the end of the line present a serious problem to most electrical utilities particularly when the industry served is an important one.

There is, however, a practical answer to peak loads or emergency needs . . . the Clark Turbo-Mobile Power Plant. This gas-turbine-driven unit is a completely self-contained, rail car mounted, generating station. Burning liquid or gaseous fuels, it can generate up to 6,750 KW, measured at the generator terminals, anywhere that there are railroad tracks. And whether the "temporary" demand lasts for a day or a year doesn't matter. The Clark unit is designed for continuous 24 hour a day service for as long as required.

Stationary gas-turbine-driven generating units can also be provided. When equipped with a regenerator, a thermal efficiency of 29% is achieved at a KW output of 6,200. When used in a combined cycle, with the exhaust gases generating steam in a waste heat boiler, up to 10,000 KW can be generated at a thermal efficiency of 29%. Both efficiencies are based upon the fuel's low heat value.

Clark engineers are available to analyze your specific applications with regard to portable or stationary gas-turbine-driven generating equipment. Consult your nearest Clark representative.

CLARK BROS. CO., OLEAN, NEW YORK
One of the Dresser Industries
Offices in Principal Cities Throughout the World

CLARK ®

Portable Generating Equipment

pumping something special?	check these special features available with Yeomans Vertical Wet Pit Centrifugal Pumps*
sand glass particles and other abrasives	*Lubri-Vac*® reduces by 95% the failure of bearings due to scoring by abrasive particles. Lubri-Vac constantly flushes bearings with lubricant, keeps foreign matter away. (An exclusive Yeomans feature included on all heavy-duty pumps.)
ash fly ash cinders bits of coal corn foots and other solids contained in drainage	A cradle pump with protective sleeves to protect shaft. Special manganese steel parts. Yeomans pumps including these features will give long life under the most severe abrasive conditions.
potassium cyanide sulphuric acid jet fuel melted naphthalene and other toxic or volatile liquids	Shaft seal is not under liquid pressure with Yeomans Vertical Wet Pit Pumps. This feature eliminates the leakage hazard which is present with horizontal pumps.
molten phosphorous acetic acid hydrochloric acid black liquor and other corrosive liquids	Whatever the corrosive and/or abrasive liquid to be pumped—Yeomans has special ferrous and non-ferrous alloy parts to handle it.

*Vertical Wet Pit Centrifugal Pumps save floor space, require no priming —no costly liquid leaks as stuffing boxes are not under liquid pressure. Capacity range from 5 g.p.m. to 10,000 g.p.m.

YEOMANS

2002-2 NORTH RUBY STREET, MELROSE PARK, ILLINOIS

☐ Please send me the catalog, "Yeomans Heavy-Duty Wet Pit Pumps."

☐ I wish to know how I may see Yeomans' 15 minute film on Wet Pit Pumps.

Name_____

Company_____

Street_____

City_____ Zone_____ State_____

REPORTS from the FIELD

Begins on page 160

it will pump liquid sodium at a temperature of 1000 F and deliver 11,800 gpm against a total dynamic head of 310 ft. It will be powered by a 900 rpm vertical, totally enclosed, forced ventilation wound rotor induction motor with speed variation from 100 to 20%.

Calendar of Events

May 4-8—Western Air Conditioning Industries Assn, Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference. Shrine Exposition Hall, Los Angeles, Calif. Details from Fred J Tabery, 3443 S Hill St, Los Angeles, Calif.

May 7-9—American Institute of Electrical Engineers, joint district meeting. Dayton-Biltmore Hotel, Dayton, Ohio. Details from AIEE, 33 W 39th St, New York 18, N. Y.

May 14-16—Industrial Nuclear Technology Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology and *Nucleonics* magazine. Museum of Science and Industry, Chicago. Details from Dr Leonard Rieffel, Armour Research Foundation, 10 W 35th St, Chicago 16, Ill.

May 20-23—American Society of Mechanical Engineers, Oil and Gas Power Conference. Kentucky Hotel, Louisville, Kentucky. Details from ASME, 29 W 39th St, New York 18, N. Y.

May 20-22—National Assn of Corrosion Engineers, northeast region spring conference on "Corrosion Control by Choice of Materials." Syracuse Univ and Hotel, Syracuse, N. Y.

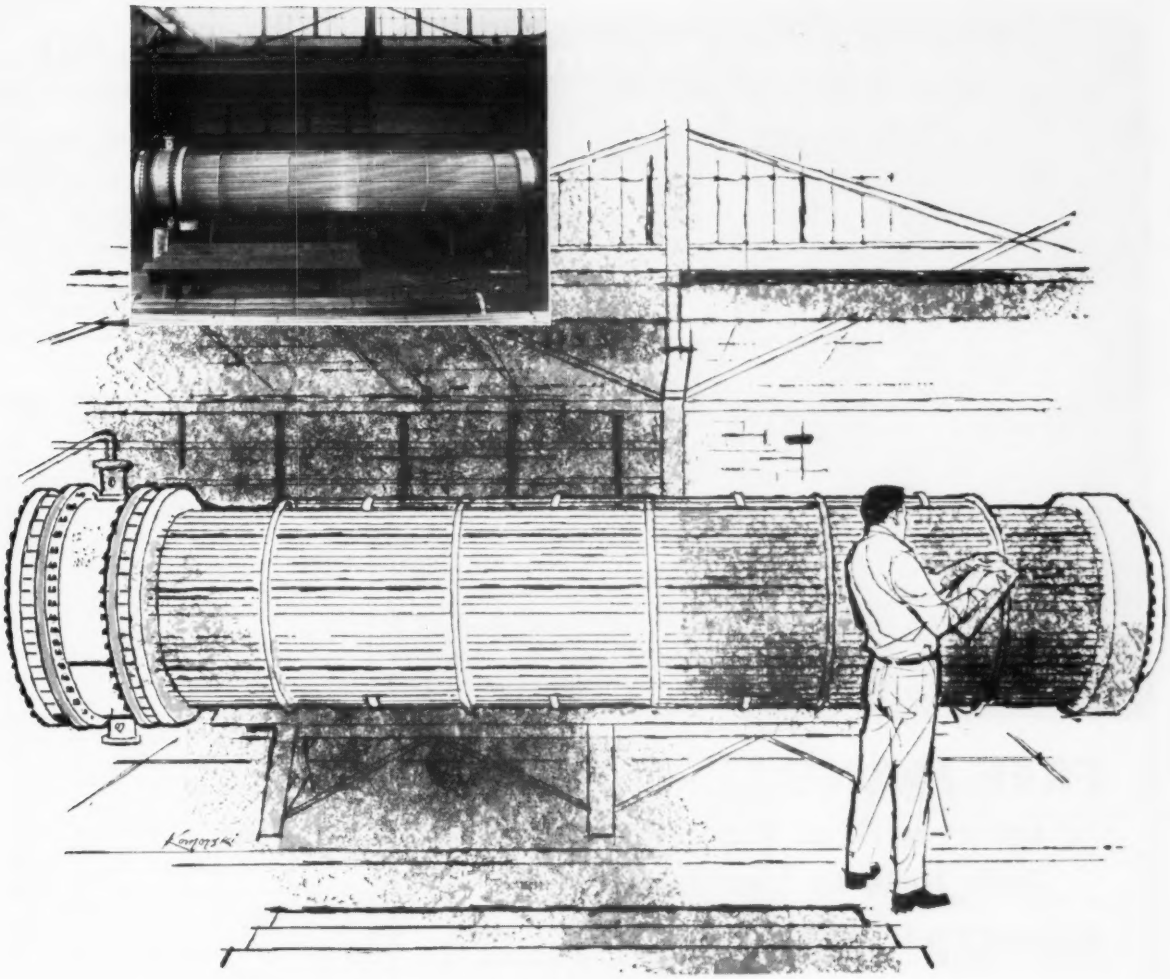
June 2-6—Air Pollution Control Assn, Golden Jubilee meeting, St. Louis, Mo. Details from APCA, 4400 5th Ave, Pittsburgh 13, Pa.

June 3-7—American Society of Civil Engineers, 1957 Spring convention. Hotel Statler, Buffalo. Details from ASCE, Engineer Park, Buffalo 7, N. Y.

June 4-5—American Institute of Electrical Engineers, Power Rectifier Conference. Morrison Hotel, Chicago, Ill. Details from AIEE, 33 W 39th St, New York 18, N. Y.

June 9-13—American Society of Mechanical Engineers, semi-annual meeting. Sheraton-Palace Hotel, San Francisco, Calif. Details from ASME, 29 W 39th St, New York 18, N. Y.

June 10-14—Technical Writers' Institute, 5th annual meeting, Rensselaer Polytechnic Institute. Details from Jay R Gould, Director, Technical Writers' Institute, Troy, N. Y. (*Continued on p.* 230)



WESTERN SUPPLY SPECIFIED ALCOA ALUMINUM ALL THE WAY

on these 100% aluminum Dilution Coolers

The exchanger illustrated is one of a number furnished by Western Supply Company, Tulsa, Oklahoma, for a recent low-pressure polyethylene installation. They selected Alcoa® Aluminum for this service because of its protection of product color and stability, good heat transfer properties and corrosion resistance. For the same reasons, aluminum has also found wide use in ammonium nitrate cooling, sour gas treatment and many low temperature processes.

As Western Supply Company sums up the case for Alcoa Aluminum Heat Exchangers: "In our experience Alcoa Aluminum is a sound, low-cost solution to many of the problems encountered in petroleum refining, natural gasoline manufacturing, petrochemical and chemical processing."

If *you* have heat transfer problems affecting tubes or other components of either the channel or shell side, investigate aluminum! Aluminum offers corrosion resistance and good heat transfer properties at minimum cost, and has excellent physical properties at extremely low temperatures. Get details in the FREE BOOKLET, *Alcoa Aluminum Heat Exchanger Tubes.* Mail the coupon today!

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

ALUMINUM COMPANY OF AMERICA
888-E Alcoa Building, Pittsburgh 19, Pa.

☐ Send me the FREE BOOKLET, Alcoa Aluminum Heat Exchanger Tubes.

☐ My heat exchanger problem is:

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

Insulation Testing Made Easy...

FREE MANUAL

for Practical Electrical Men Tells How to Use the Popular

MEGGER® INSULATION TESTER

The Meg type of Megger insulation tester shown above is perhaps the most popular and most-used tester there is. It is available with a hand-crank generator for field use and with a separate or built-in power supply for repetitive inspection or production tests. Ranges available up to 2000 megohms, 1000 volts d.c. Optional accessory features include ohm scales 0 to 10,000 ohms and ratio and discharge switches.

The answers to many of your electrical maintenance problems are in the 100-page "Manual on Megger Insulation Testers". It answers questions like these:

What makes good insulation go bad?
How can you check it before it breaks down?
How does a Megger insulation tester work?
What testing procedures should be practiced?
How to interpret meter readings?
Does periodic testing pay off?

Write now on your company letterhead for this valuable manual together with helpful material on the practical and economical advantages of electrical preventive maintenance.

Write for BULLETIN 21-J-P.

8703

JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

REPORTS from the FIELD

Begins on page 160

June 10-Aug 30 — Gordon Research Conferences for 1957. Held at: Colby Junior College, New London, New Hampshire; New Hampton School, New Hampton, New Hampshire; and Kimball Union Academy, Meriden, New Hampshire. Details from W George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, Rhode Island. After June 10, address mail to Colby Junior College, New London, New Hampshire.

June 11-14—Third Western Plant Maintenance and Engineering Show and Conference. Civic Auditorium, San Francisco. Details from Western Office, 759 Monadnock Bldg, San Francisco 5, Calif.

June 16-29—4th Annual Material Handling Training Conference. Industrial Management Center, Lake Placid, N. Y. Details from James R Bright, Industrial Management Center, 56 Robbins Rd, Lexington 73, Mass.

June 16-21 — American Society for Testing Materials, annual meeting. Chalfonte-Haddon Hall, Atlantic City, N. J. Details from ASTM, 1916 Race St, Philadelphia 3, Pa.

June 17-21—American Society for Engineering Education, 1957 annual meeting. Cornell University, Ithaca, N. Y. Details from ASEE, University of Illinois, Urbana, Ill.

June 17-21—5th Annual Human Engineering Institute. Stamford, Conn. Details from H E Blank, Jr, Dunlap & Assoc Inc, 429 Atlantic St, Stamford, Conn.

June 24-28 — American Institute of Electrical Engineers, summer general meeting. Buffalo, N. Y. Details from AIEE, 33 W 39th St, New York 18, N. Y.

PP&L lays plans now for future atomic power plant

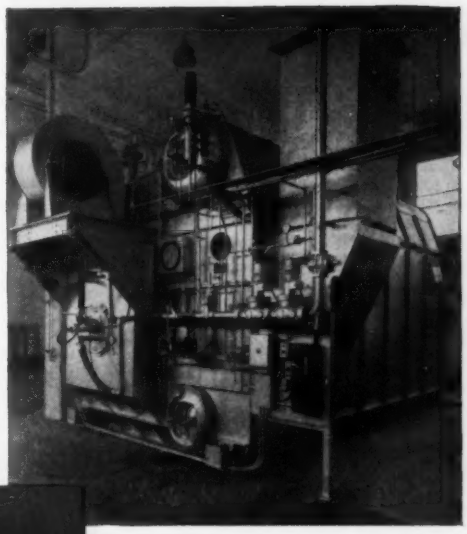
► Pacific Power & Light Co has acquired about 14 sq miles of land near the Hanford Atomic Energy Works reservation in Washington to have a site available for a future atomic power plant.

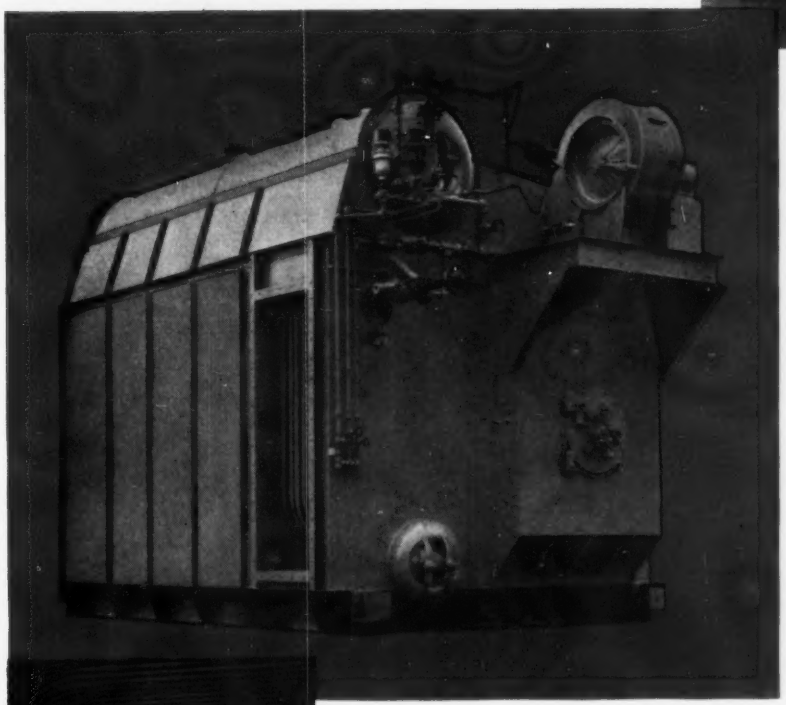
Announcement of the acquisition was made in Yakima by Paul B McKee, PP&L president.

Part of the 9000 acre tract has been purchased. Pacific will exercise the options it holds on the rest of the land soon, McKee said.

Active interest of PP&L, Washington Water Power, Portland General Electric and Montana Power companies in atomic power possibilities has been indicated by letter to Admiral Lewis

packaged power for limited space requirements . . .





KEELER

Type D-K

a comparatively wide and short boiler incorporating the proven efficiency and economy of Keeler Water Tube Steam Generators in a compact, low cost unit

Where boiler room space is definitely limited, the KEELER TYPE D-K Water Tube Package Steam Generator is the answer to your problem! It's a comparatively wide and short boiler for use where long boilers of other types cannot be accommodated.

KEELER TYPE D-K Package Boilers are made in oil or gas fired units with capacities from 8000 to 45000-lbs. of steam per hour–standard design pressures of 200 psi and maximum design pressures of 500 psi. The furnace sides, roof and floor, as well as front and rear walls, are water cooled and insulated. The complete "package", ready for quick hook-up and operation, includes all burning equipment, controls, safety devices and accessories.

For a low first cost, low operating cost outfit, you'll want the full particulars on this compact Package Power Plant! Write or phone . . . there's a KEELER representative at your service in your locality.

Write For Bulletins

No. DK-1: Type DK Package Boilers
No. F-14: Type CP Package Boilers
No. M-2A: Type CPM Package Boilers
No. MK-1: Type MK Boilers

The Seal of Quality in Water Tube Boilers

— ESTABLISHED 1864 —

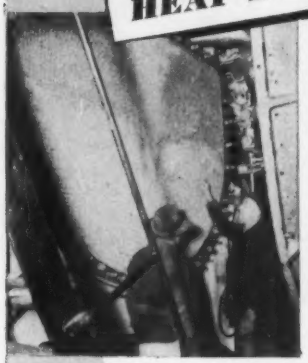
E. KEELER CO.

200-300 West St. • WILLIAMSPORT PA.

— OFFICES IN PRINCIPAL CITIES —

KEELER WATER TUBE Boilers

For the Finest
in
CONDENSER and HEAT EXCHANGER *Servicing*



call on

UNION ENGINEERING

specialists

New York's pioneer marine servicing contractor employs only the most modern facilities, including Electronic Rolling—Armstrong Tube Removing—Spectrotest Leak Testing for Chemical, Commercial, Industrial and Marine Installations

Repairing, Retubing, Redesigning, Rebuilding and Testing of:

- Condensers
- Feed Water Heaters
- Fuel Oil Heaters
- Lube Oil Coolers
- Drain Coolers
- Evaporators
- Refrigeration Condensers
- Finned Tubing Installations
- Heaters and Coolers, Chemical and Petroleum
- Tube Sheets
- Water Coolers

and The new SULFAMIC ACID cleaning process for safe descaling of salt water deposits

Our day and night service includes pickup and delivery of units repaired in our shop

For brochure and further information — Call or Write

UNION ENGINEERING CORPORATION

First and Clinton Streets
REctor 2-4438

Hoboken, New Jersey
OLdfield 9-0280

This slow, positive speed Viking pump is ideal for handling heavy oils. It is connected through combination V-belt and gear to standard 1800 RPM motor. Shown with top half of guards removed.

If your problem is to handle heavy heating oils, you will find Viking pumps unbelievably smooth and dependable. And if you have never used a Viking, you're really in for a pleasant surprise.

No matter what capacity you want, there is a Viking pump in the size and type to do the job. For more information, send for Bulletin 575w today.

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "*ROTO-KING*" pumps

See our catalog in Sweets

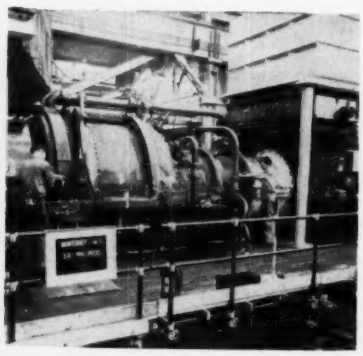
REPORTS from the FIELD

Begins on page 160

Strauss, chairman of the Atomic Energy Commission.

All or part of this group might be participants in the future construction of an atomic plant on the site which Pacific now has available for such a purpose Strauss was told.

Possibilities of nuclear energy are of special interest to the Pacific Northwest because of lack of native oil and gas in the area, McKee commented.



Largest gas turbine assembled for GE tests

► LARGEST CAPACITY gas turbine yet manufactured in the Western Hemisphere is assembled for tests in GE's Gas Turbine Dept, Schenectady, N. Y.

This is the first of two 16,000-kw gas turbines ordered from the Gas Turbine Department by the Planta Electrica de Grupo Industrial in Monterrey, Mexico. This organization furnishes electricity to a complex of industrial concerns in the greater Monterrey area.

The units are of GE's simple-cycle, single-shaft design. Nominal rating of 16,000 kw is for operation at a temperature of 80 F with a compressor inlet air pressure of 14.17 psia. Natural gas will be burned as fuel. Units will drive hydrogen-cooled generators rated at 17,647 kva. They were sold through the International General Electric Co, the company's foreign marketing organization, and are scheduled to be in operation by mid-1957.

Company probes possibility of geothermal power project

► A VENTURE which may lead to the nation's first geothermal power development has been launched in San Francisco with formation of Thermal Power Co.

The firm plans to drill three wells in the Big Geysers area near Heraldsburg, Calif, to determine whether it

Burn COAL the MODERN WAY

with DETROIT STOKERS and SAVE!

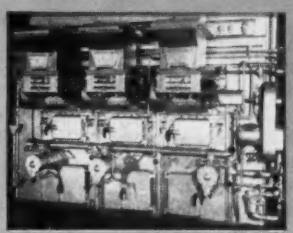
Coal is the economical fuel in most industrial areas. Safest to handle and store, its steady and continued supply is assured by huge reserves.

With a Detroit Stoker you can burn coal the modern way . . . saving 10% to 40% over other fuels.

Detroit Stokers are dependable, durable . . . last for decades. There is a type of Detroit Stoker to meet your needs.

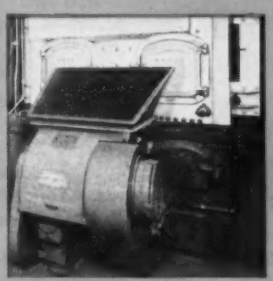
Let us show you the savings available. Recommendations by our engineers will cost you nothing.

DETROIT ROTOSTOKER



Spreader stoker. Economically burns all grades of Bituminous coal or Lignite. Power, hand dumping or stationary grate types.

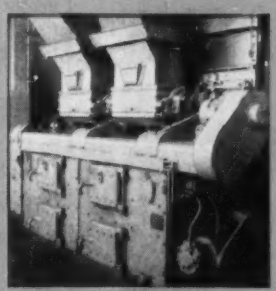
DETROIT LOSTOKER



Compact underfeed stoker for smaller boilers. Capacities 3,000 to 12,000 pounds steam per hour. Plunger feed, mechanically driven side cleaning. Coal feed and air supply may be automatically controlled.

DETROIT ROTOSTOKER—TYPE C-C

(Continuous Cleaning) Reciprocating grates that slowly discharge ash at front. Steaming capacities from approximately 5,000 to 75,000 pounds. Smokeless with wide load range.

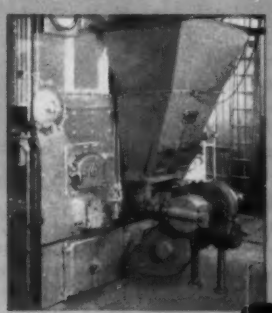


DETROIT SINGLE RETORT STOKER
(Detroit UniStoker)

Side cleaning, underfeed stokers. Motor or turbine driven. Adjustable feed provides manual and automatic control. Capacity range 12,000 to 24,000 pounds steam per hour.

DETROIT ROTOGRATE STOKER

Spreader stoker for higher capacities up to 400,000 pounds. Forward moving grates that discharge ash at the front. Higher burning rates for longer periods. Heavy duty.



DETROIT DOUBLE RETORT STOKER

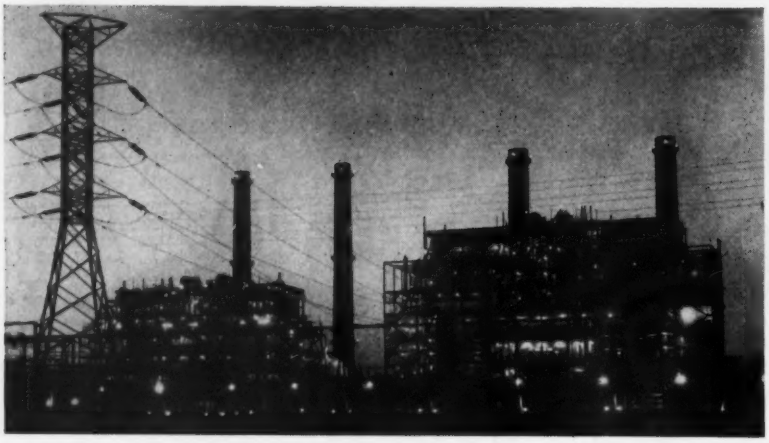
Side cleaning heavy duty underfeed stoker with two retorts, mechanically driven. Available for capacities from approximately 20,000 to 34,000 pounds steam per hour. Requires no basement.

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

DETROIT SINCE 1898 STOKERS



Non-Stop Service

SWECO fuel oil heating systems serve 512,000 kw. steam plant of the nation's largest municipal electric utility.

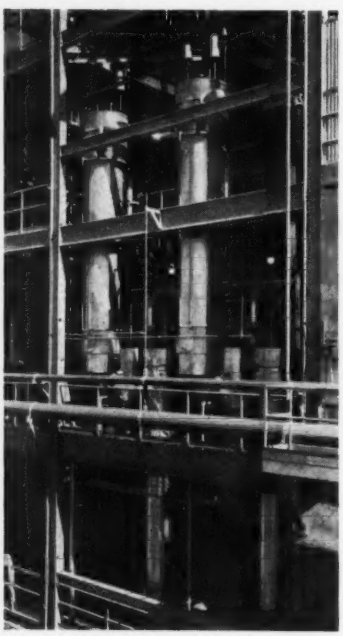
Long before they were ready to equip the new $80,000,000 Valley Steam Plant with fuel oil heating systems, engineers of the Los Angeles Department of Water and Power knew what they had to have: heat exchange equipment of absolute reliability for generating cheap, unfailing power...around the clock, around the calendar. From past experience at other installations, they knew of SWECO's ability to supply efficient fuel oil heaters, drain coolers and suction heaters. Bids were let and SWECO got the job.

Initially, SWECO built four sets of heaters (two for warm standby) for the first two of the plant's big generating units. Each set includes a heater, drain cooler and hot well. On a recent repeat order, this equipment was virtually duplicated.

The SWECO systems exchange 4,670,000 B.t.u. in preheating 860 barrels of fuel oil an hour. Each heater circulates 100% saturated steam at 4,380 lb. per hour on the shell side and 75,000 lb. of 8.8 API gravity fuel oil an hour on the tube side. Operating at a pressure of 75 p.s.i., the heaters raise tube side temperatures to 250°F. Condensate entering the drain coolers at 320°F. heats fuel oil to 136°F. in a single crossflow pass.

SWECO is providing process efficiency like this for major companies across the country through... the design and manufacture of heat exchangers, feed-water heaters, pressure vessels, distillation columns, steam jet ejectors and surface condensers... a complete line of *vibrating screen separators*... and *engineering and construction services.*

Write today for complete information on SWECO process equipment. Ask for brochure M-2-393.



Two fuel oil heaters and a drain cooler *(bottom)* serve each generating unit at Valley Steam Plant. To maintain proper combustion, fuel oil is heated to 250°F.

SWECO

Southwestern Engineering Company

4800 Santa Fe Ave., Los Angeles 58, Calif.
Engineers, Constructors... Manufacturers

REPORTS from the FIELD

Begins on page 160

would be economic to tap the geothermal steam resources there for running power plant turbines.

If results are favorable, the firm hopes to reach an agreement with Pacific Gas & Electric for sale of power to the utility.

Dan A McMillan Jr, president of the new firm, said PG&E has indicated Thermal would have to build a plant with capacity of at least 12,500 kw to justify construction of a transmission line.

The company has just announced a public stock offering of 199,998 shares at $1 a share to finance the drilling program. The wells will give a better idea of the quantity of steam available and how long it is likely to last.

Roger Rhoades, San Francisco, one of several consulting geologists who have examined the area, reported the heat source appears to be deep and large enough to last for hundreds or thousands of years. The big question he said is whether the underground channels are open enough to admit the necessary amount of water to the heat source.

The steam has such a small corrosive content that Thermal Power believes no unusual protective measures would be needed for steam turbines. McMillan claims the field has the best quality geothermal steam in the world.

If Thermal decides to go ahead with the project it will build a generating plant and drill additional wells to supply it.

Midwest utilities announce plans for atomic plant

► A GROUP of midwest electric utilities has announced that it will construct a full scale atomic power plant of advanced design. At the same time, Fred C Kellog, President of Pioneer Service and Engineering Co, whose firm has participated in developing the project, announced that Pioneer will act as architect-engineer.

It is estimated that the proposed 60,000-kw plant will cost about $20- to $25-million and will be completed by 1962.

Subject to the approval of the AEC, the plant would be located on a site, yet to be chosen, on the system of the Northern States Power Co, which would own and operate the plant. This system was chosen because of its size, the extent of its transmission system, and the ability of the company to meet any production delays or difficulties that may occur during preliminary tests. Major interconnections between

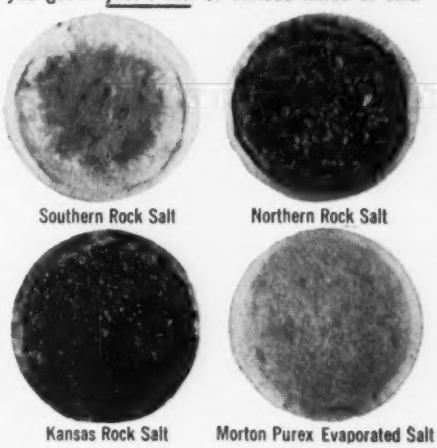
Switch to sludge-free Purex Salt

In every 100 lbs. of rock salt you buy you assume the risk of paying for up to 5 lbs. of insolubles or sludge—shale and sulphates. This means that in a 50-ton carload of rock salt you may pay for as much as 5,000 lbs. of sludge! This insoluble matter is included in the purchase price of the rock salt and accounts for part of your freight bill. It also necessitates periodic cleaning out of your brine making system.

But when you buy Morton Purex Salt, you get high-purity evaporated salt that is made in a controlled particle size to prevent packing and channeling. With Purex, none of your purchase price or freight bill goes toward paying for insolubles or sludge.

With Purex, no time or labor is wasted in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex Salt will leave no accumulation of material in either the brine or water softener tanks. It can be used in bulk wet storage systems and in the Morton Model E Brinemaker.

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.



Southern Rock Salt | Northern Rock Salt

Kansas Rock Salt | Morton Purex Evaporated Salt

Tests for insolubles taken from these random samples show you that Morton Purex is the only one that contains no wasteful sludge, or insolubles.

For more information about Morton Purex Salt and for free, expert help on any water softening or brine making problem, write or wire:

MORTON SALT COMPANY
INDUSTRIAL DIVISION
Dept. P-5, 120 So. LaSalle Street,
Chicago 3, Illinois

No gauge glass shutdowns for you

A broken gauge glass could seriously affect a plant's operation.

But it's improbable that it will ever happen to you because your distributor carries CORNING®, PYREX®, and MACBETH® gauge glasses.

Your distributor is a forward-looking businessman who's going to make sure that you get gauge glass service when you need it. You can depend on him.

The glasses he sends you will be naturally longer lived. They fit better, they stand up better to temperature changes, to corrosive effects, to just about every hazard they'd be exposed to.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	*Recommended Product*
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Heavy-duty service	MACBETH brand flat gauge glasses
Viewing inside furnaces, reactors, pressure vessels, etc.	PYREX brand sight glasses
Lubrication inspection	PYREX brand lubricator glasses
Visible discharge devices	PYREX brand oil cup glasses

CORNING GLASS WORKS
Corning, New York

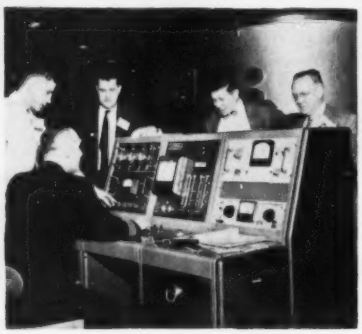
Corning means research in Glass

REPORTS from the FIELD

Begins on page 160

companies will permit energy produced by the atomic power plant to flow into the systems of the participating companies.

Announcement of this full-scale atomic plant brings to 19 the number of atomic plants presently planned for the U.S. Total generating capability of these plants will be nearly one and one-half million kw. Three are scheduled to be in operation this year and the rest of them by 1962. More than sixty utility companies have united to build and operate ten of these nineteen plants.



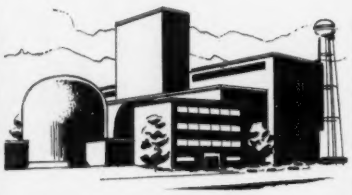
Crowds view live reactor at six-day Nuclear Congress

► THE GENTLEMAN SHOWN above is guiding, alone and for the first time, a nuclear chain reaction. Scene of his solo: Philadelphia's jam-packed Convention Hall.

In a day when the very mention of a neighborhood reactor makes public hackles rise, it was a remarkable exhibition. Some twelve thousand people visited the Hall during the six-day Nuclear Congress to view the AGN 201 at work. At least 200 of them, scientists and engineers, were given the opportunity to sit at its controls.

Exhibitors of the unit, Aerojet-General Nucleonics, are excited over the public's reaction. Not only is this their first exhibition of a live reactor, it's the first one shown anywhere. Success of the exhibition and the attitude of the public is, they believe, dramatic proof of the complete safety of the mass-produced reactor.

The most modern test pit of its kind in the country is claimed by Allis-Chalmers. The pit, which has been placed in service at A-C's West Allis Works, will be used for precision balancing and overspeeding of turbine generator rotors of all sizes. Tests will take place under temperatures simulating actual operation.



PREPARE YOURSELF FOR ATOMIC POWER PLANTS WITH HOME STUDY

Are you studying nuclear plant operation? Where will you be when nuclear plant engineers are needed?

By 1960 the projections are for ½ million KW capacity from atomic power plants. Just as television engineering made overnight demands for skilled operators, so atomic power plants will need trained personnel urgently.

We are preparing a practical training course in atomic power plant operation and maintenance. No supplementary texts need be purchased. With a high school education you can readily familiarize yourself with the working knowledge. All necessary mathematics, chemistry and physics are a part of the course.

FREE outline of home study course sent without obligation. Contains all details of course of study, and cost. Your future is influenced by what you plan and study *today*. Full information sent by return mail.

STEINER NUCLEAR SERVICES
Since 1930
5224 Fairlawn Ave. Baltimore 15, Md.

Fight Mental Illness

Give...

LOCALLY TO THE
National Association for Mental Health

Byron Jackson announces FIRST 4 in 1 Condensate Pump!

1. Saves valuable floor space 2. One driver serves four pumps 3. Common shaft for all units gives increased reliability

This new Byron Jackson vertical unit actually contains four pumps in a common case, utilizing a common shaft. It saves valuable floor space and cuts operating costs because a single electric motor serves four pumps. Reliability of operation is increased because the use of a common shaft requires only a single stuffingbox – reducing packing maintenance. Three of the four pumps are single-stage and the fourth is a two-stage with external crossover. Axial and radial hydraulic balance is obtained by using double suction impellers and double voluted pump cases.

The outer casing is the vertically split type, with the four sets of inlet and outlet nozzles located in one half to allow the removal of the rotating element without disturbing the suction or discharge piping.

This pump has been successfully used for more than a year by a major power company. It was specially engineered by Byron Jackson to meet particular requirements of Burns & Roe, Inc., engineers and constructors in the power generating field. If space-saving is an important consideration in your plant, this new BJ multi-pump is designed for you. Call your nearby BJ Pump sales engineer or write:

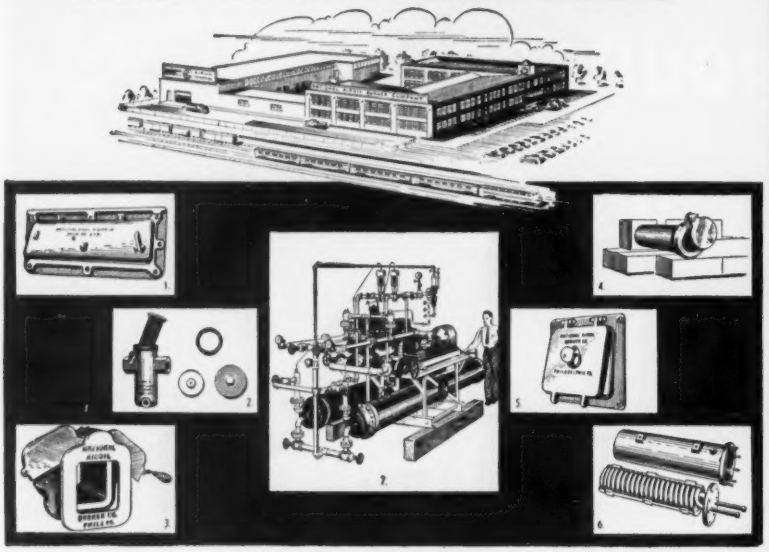
BJ

Byron Jackson Pumps, Inc.
A Subsidiary of Borg-Warner Corporation

P.O. Box 2017A
Terminal Annex
Los Angeles 54, California

A Complete Line of

COMBUSTION ACCESSORIES



***for* EVERY**

INDUSTRIAL LIQUID FUEL-GAS INSTALLATION

1. Air Control Door and Frame, top hinged, ratchet type, heavy duty, for manual control. Surfaces are machined to a close fit.
2. Fuel Oil Suction Strainer, single type. Large basket area insures low pressure drop; cover and basket easily removed for cleaning.
3. Wide-View Peephole, safety, curtain type. Cobalt glass removed to show bearing surface for curtain. Curtain halves are interlocked—open simultaneously.
4. Ignition Port with Refractory Tile No. M896 . . . for use with standard 3" pipe. Also serves as a peephole.
5. Furnace Relief and Access Door, heavy construction, practically air tight. Door casting correctly weighted, lined with plastic refractory retained by imbedded grill; with observation port and cover.
6. Fuel Oil Heater, Self-Cleaning, Spiral Coil type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.
7. Fuel Oil Pumping and Heating Unit . . . Twin or Single Pumps, Steam driven, Electric driven or combination Steam-Electric, with Single or Double Fuel Oil Heaters and accessories for feeding oil at constant pressure and temperature.

. . . yes, just as we are proud of supplying the *right* liquid fuel or gas burning equipment (over 40 years experience throughout industry), so, also, are we proud of our full line of highest quality accessories to supplement your every combustion need. Within our modern, "daylight" factory, salesrooms and general offices NATIONAL AIROIL likes and adheres to the phrase, "nothing but the best"! We believe that our record speaks for itself . . . i.e.; the "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil and Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation.

May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

BOOKSHELF

Applied Electrical Measurements. *By Isaac F Kinnard, Manager, Engineering, Instrument Department, General Electric Company, West Lynn, Mass. 600 pp, illust, $15.00. John Wiley & Sons, Inc, 440 4th Avenue, New York 16, N. Y.*

This thorough book covers the whole field of electrical measurements, and is divided into two parts, the first dealing with the measurement of electrical quantities, the second treating the measurement of non-electric quantities for which electric instruments are adapted. Part I carefully develops the theory of electrical measurements and units, together with standard definitions. The principles and constructional features of each type of instrument are discussed and illustrated. Electric instruments include, besides the familiar types, Q-meters, thermal, electronic and induction wattmeters, phase angle meters, frequency meters, oscilloscopes and magnetic flux meters. There's a long chapter on telemetering.

Part II includes applications of electrical instruments for measuring light, heat, sound, time, liquids, etc. Medical uses are covered. The final chapter on applications relates various instrument types to specific measuring tasks.

Dr Kinnard's associates at the General Electric Instrument Department contributed to the book.

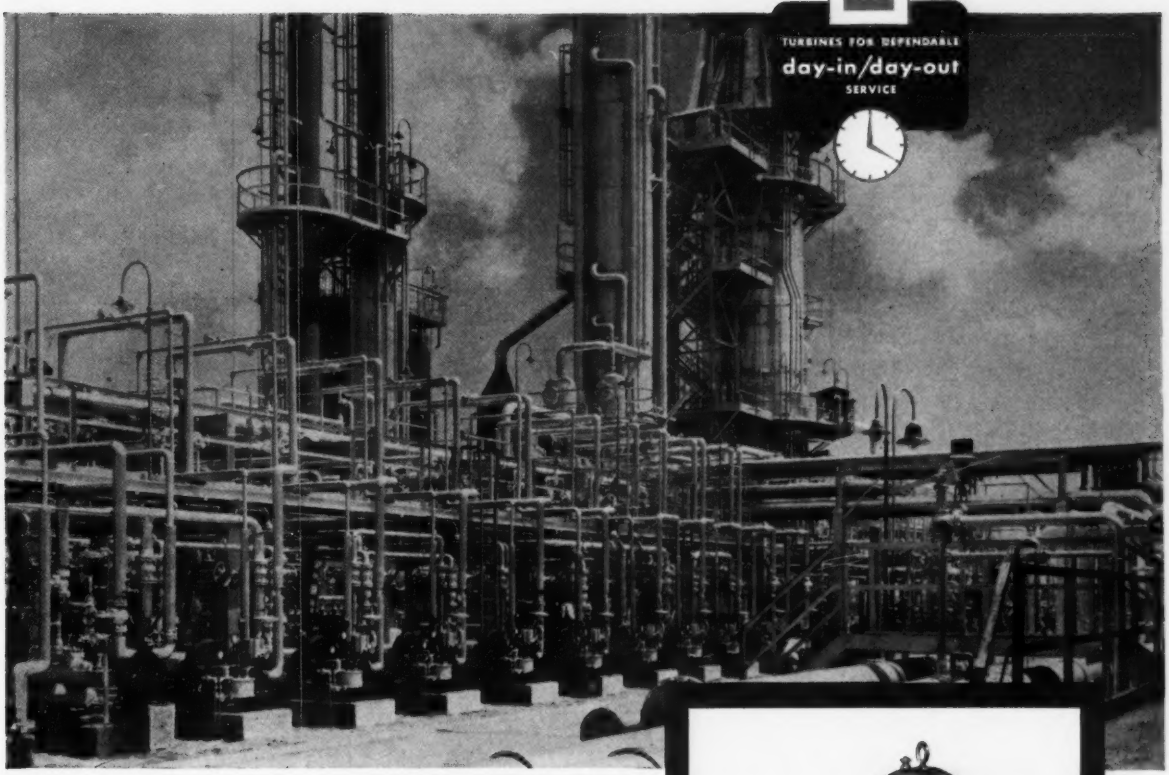
The Art and Science of Protective Relaying. *By C Russel Mason, Engineering Planning and Development Section, General Electric Company, Schenectady, N. Y. 410 pp, illust, $12.00. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

This textbook fills a long-felt need in the field of protective relaying. Author treats the subject thoroughly, giving adequate background theory necessary to understand modern relaying techniques. While mathematics are kept to a minimum, subject is presented on a sound engineering basis. The book grew out of notes prepared for Power Systems Engineering Course taught by the author at General Electric. No prior knowledge of protective relaying is assumed, but the book is of considerable value to practicing engineers.

Protection of entire ac power system from generators to motors is described, including transformers, buses and transmission lines. Relays and relaying practices for short-circuits and other types of faults are described in detail. Schematic diagrams are used throughout to illustrate circuits and relay principles.

Elevated Temperature Properties of Carbon Steels. *ASTM Technical Publication No. 180. 9x12, 68 pp, paper. $3.75. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

This is the fourth publication in a current series prepared under the auspices of



ELLIOTT YR TURBINES

the best anywhere . . .
serve refineries everywhere

When it comes to prime movers for process and water pumps, fans or compressors, Elliott mechanical drive turbines are the simple and reliable solution. Elliott single-stage turbines, ranging in size from 2 to 600 hp, are specifically designed to provide highest quality and long-term continuous service. In the cat cracker above, a southwestern refinery, 75 Elliott turbines furnish dependable driving power—24 hours a day.

The Elliott YR turbine design also permits easy inspection, simple replacement of wearing parts, and interchangeable components from one turbine frame to another. What's more, your local Elliott field engineer is always available for application engineering or for operating or maintenance assistance. Call today, or write Elliott Company, Steam Turbine Division, Jeannette, Pa. Ask for Bulletin H-22B.

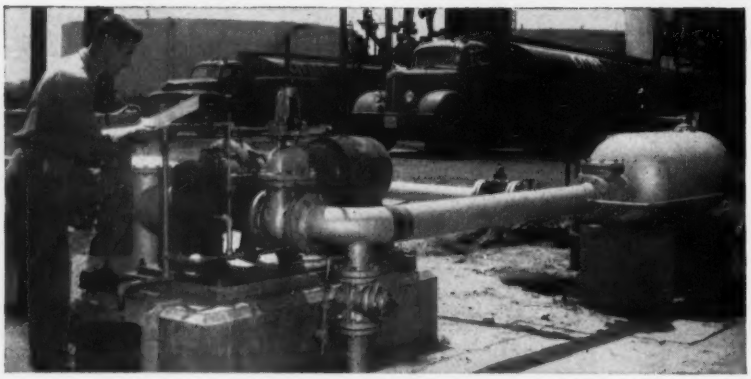
6 design features you get with ELLIOTT YR single-stage turbines

- True Centerline Support for precise alignment, cold or hot, simplifies installation.
- Weather-Proofed, Reliable Governing System with separate overspeed trip and valve.
- Liner Type Bearings, easy to inspect or replace, rapid heat transfer to cooling oil, sealed against elements.
- Accessible Shaft Seals. Covers—not part of turbine casing—are easily removed for inspection or ring replacement.
- Self-Locating Rotor drops into position without adjustments. Entire rotor is dynamically balanced.
- Interchangeable Components permit interchanging of parts between turbine frame sizes, eliminates need for large inventories.

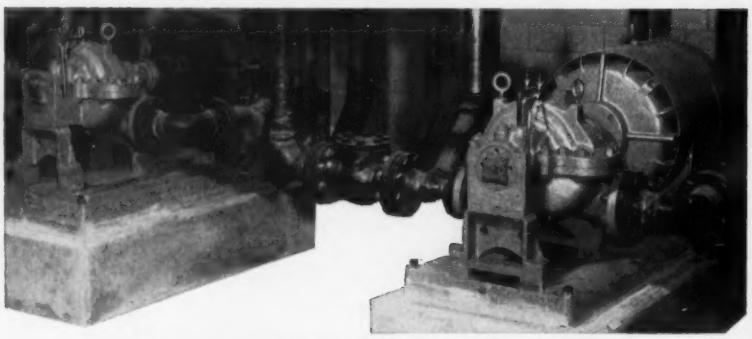
M7-1

ELLIOTT Company

Steam Turbines • Motors • Generators • Deaerating Heaters • Ejectors • Condensers • Centrifugal Compressors • Turbochargers • Tube Cleaners • Strainers



They needed pumping capacity



They needed pumping pressure

You can have capacity . . . or pressure . . . or both

You can meet an exceptionally wide range of pumping needs with just two types of Goulds pumps.

For volume pumping—33 sizes of the Fig. 3405 single-stage, double-suction pump provide capacities up to 6400 GPM, heads up to 425 ft.

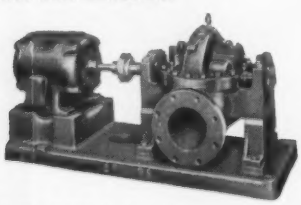
For great pressure—5 sizes of the Fig. 3305 two-stage pump provide heads up to 1000 ft., capacities to 1200 GPM.

All these *extra* features are *standard* on both groups:

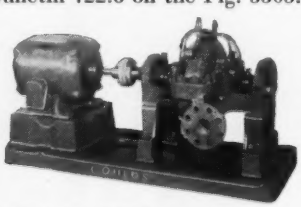
1. Bearing housings sealed against dust and moisture.
2. Renewable stuffing box bushings.
3. Die-formed stuffing box packing.
4. Cowl-type glands for use with quenching fluids.
5. Corrosion resistant gland bolts.
6. Stainless steel impeller keys.
7. Teflon water seal rings.

Because so many parts on these pumps are interchangeable—you can cut parts inventory in two or better.

For further information write for Bulletin 721.6 on the Fig. 3405; Bulletin 722.6 on the Fig. 3305.



Goulds Fig. 3405 single-stage pump.



Goulds Fig. 3305 two-stage pump.

MEMBER

Goulds PUMPS INC. Seneca Falls New York

Branches: Atlanta • Boston Chicago • Houston New York • Philadelphia Pittsburgh • Tulsa

West Coast Representative: Goulds Pumps Western, Portland, Ore.
In Canada: The A. R. Williams Machinery Co., Ltd. in all principal cities.

More BOOKSHELF

Begins on page 238

the ASTM-ASME Joint Committee on the Effect of Temperature on the Elevated Temperature Properties of Metals. This series was started to incorporate in one book the available elevated-temperature data on a particular "family" of metals.

This "carbon-steel compilation" includes data for tensile and yield strength, elongation and reduction of area, stresses for creep rates of 0.0001 and 0.00001% per hour and rupture strengths for 10, 1000, 10,000 and 100,000 hours.

The steels covered are killed carbon steel (0.18 to 0.24 C), ASTM A 201 Grade B plant steel (0.24 C max), ASTM A 106 Grade B pipe steel (0.30 C max), killed carbon steel (0.27 to 0.58 C), aluminum killed steel, open steel (rimmed or capped), and miscellaneous carbon steels (limited data available).

The properties are given in graphical form and supplemented by copies of original data sheets from those contributing the data.

The previous reports include Elevated Temperature Properties of Stainless Steels (ASTM STP No. 124), Elevated Temperature Properties of Chromium Molybdenum Steels (ACTM STP No. 151), and Elevated Temperature Properties of Selected Super-Strength Alloys (ASTM STP No. 160).

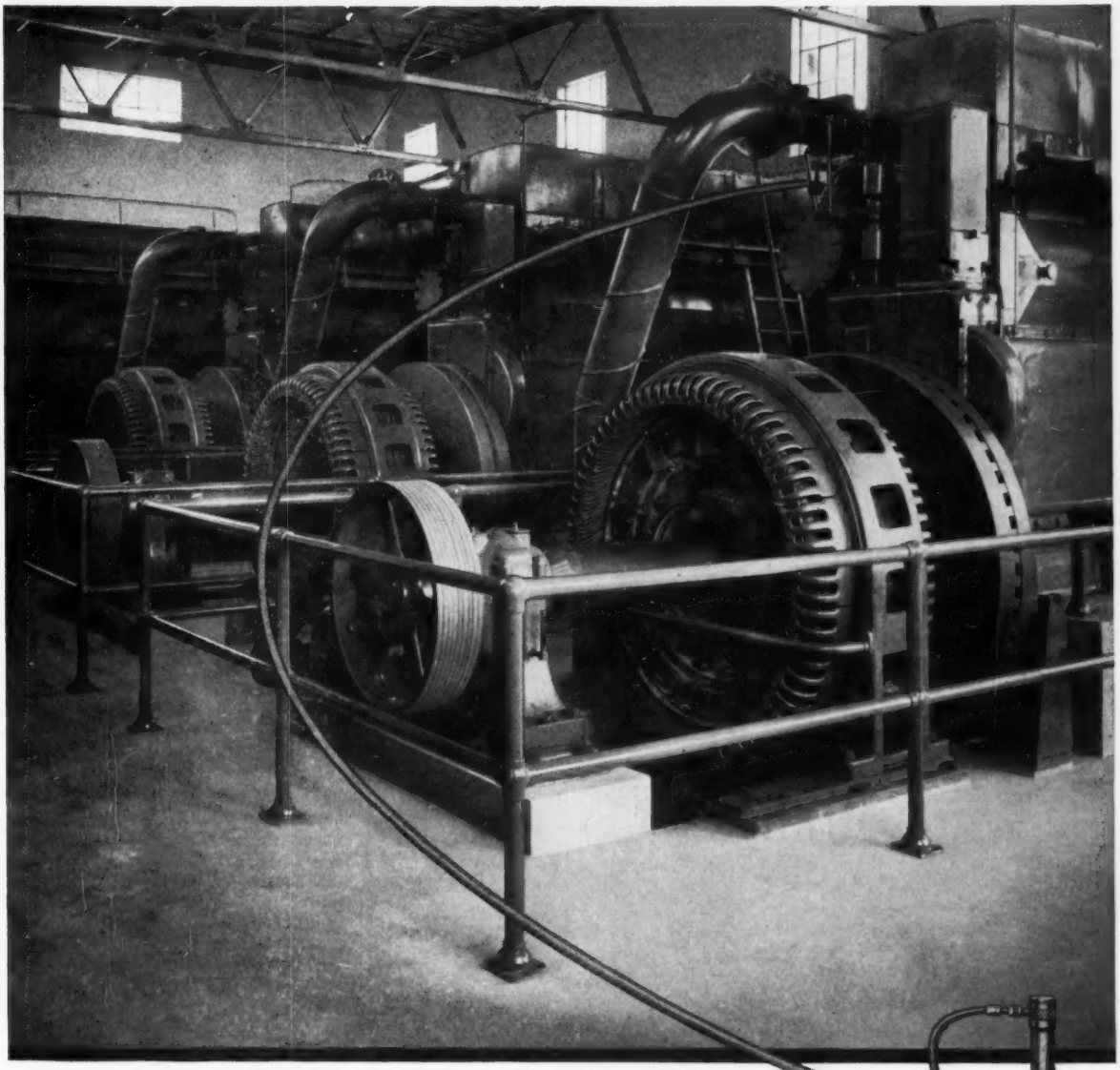
ASTM Standards on Light Metals and Alloys, Cast and Wrought. *6x9, 276 pp, illust, paper. $3.50. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

Sponsored by Committee B-7 on Light Metals and Alloys, this volume includes not only those specifications and methods of test which come under the jurisdiction of Committee B-17, but also those for light-metal-alloy die castings prepared by Committee B-6 on Die Castings, and those for aluminum wire and cable for electrical purposes sponsored by Committee B-1 on Wires for Electrical Conductors. Several methods under the jurisdiction of Committee E-1 on Methods of Testing, and Committee E-3 on Chemical Analysis of Metals, as well as specifications for aluminum and aluminum alloy arc-welding electrodes and for brazing filler metal under the jurisdiction of the AWS-ASTM Joint Committee on Filler Metal, have been included to round out the compilation.

The standards include ingots, castings, bars, rods, wire, forgings, pipe and tube, sheet and plate, wrought products for electrical purposes filler metal, electroplating, and general methods of test. Also included is the ASTM codification system for light metals and alloys.

Significance of ASTM Tests for Petroleum Products. *Technical Publication No. 7-B. 6x9, 134 pp, paper $2.50, cloth $3.25. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

This volume concisely outlines the significance of the various ASTM methods



NO STUCK RINGS!

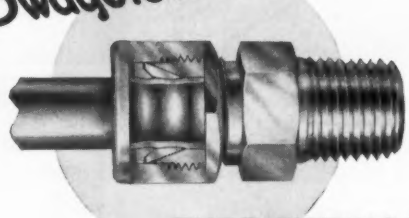
Stop the formation of varnish, sludge and carbon in your Diesels and *keep it stopped* with Sinclair RUBILENE®, the high viscosity index oils proved by over 35 years in industrial Diesel applications. RUBILENE earns its reputation by its performance under continuous operation and heavier loads. It fights deposits and gives better protection to cylinders, pistons, rings and other vital moving parts. Your Diesel stays on the job longer . . . service time is cut 'way 'way down!

Let RUBILENE help solve your lubrication problems. Regardless of the make or age of your Diesel, where a high VI oil is needed, there's a member of Sinclair's RUBILENE or RUBILENE HD family that meets your requirements exactly. Call your local Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Ave., New York 20, N. Y. *There's no obligation.*

SINCLAIR RUBILENE OILS

Only
one
name
identifies
the
finest
in
fittings

Swagelok®



TUBE FITTINGS

There is a Swagelok Specialist in your area. For catalog, write Dept. E5

CRAWFORD FITTING COMPANY
884 East 140th Street • Cleveland 10, Ohio

More BOOKSHELF

Begins on page 238

of test related to petroleum products. It also calls attention to their limitations. It has been prepared for petroleum executives, scientists, engineers, laboratory technicians, and those concerned with the properties of petroleum products and the tests thereof. It will help them to acquire a general idea of the various methods of test and to understand performance characteristics of specific products and the significance of the properties of petroleum products in relation to one another. The language has been kept relatively free of technical terms.

Each chapter discusses a particular property or characteristic, covering the importance of sampling, selection of test apparatus, the methods of test which apply and their significance. Full details of the individual test procedures are not published in this volume, but are found in the annually published compilation "ASTM Standards on Petroleum Products and Lubricants."

An Introduction to Reactor Physics. *By D J Littler and J F Raffle. Published for the United Kingdom Atomic Energy Authority. 8 x 6, 196 pp, illust, $4.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

This book grew out of lectures given by the authors to the Reactor School at the Atomic Energy Research Establishment, Harwell, England. First chapters deal with nuclear physics in a highly mathematical treatment. Then follows a detailed calculation to evaluate the critical size of a gas-cooled graphite-moderated natural-uranium reactor. This type of reactor will be used in the UK's first nuclear power stations.

The book closes with chapters on shielding, reactor instrumentation and structural damage from high radiation fluxes. Almost all illustrations are graphs with none showing the arrangements of a reactor or reactor components. Principal readers that the authors had in mind were college students studying physics or engineering and scientists interested in power reactors.

Power System Stability, Vol III. *By Edward Wilson Kimbark, Dean of the School of Engineering, Seattle University. 322 pp, $10.00. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

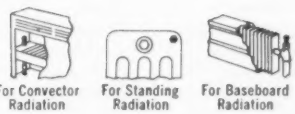
Book deals with the theory of synchronous machines and their excitation systems. By discussing such effects as saliency, damping, saturation, and high-speed excitation, Vol III lends a deeper knowledge of power-system stability than that available through Vol I alone. Book also delves fully into reactances, resistances, time constants, sudden three-phase short circuit, mathematical theory, vector diagrams and applications to transient stability studies. Individual chapters appear on excitation systems, damper windings and damping, and steady-state stability.

HOFFMAN WATER VENTS

FOR RESIDENTIAL, INDUSTRIAL AND PROCESS APPLICATIONS

VENT THE AIR AUTOMATICALLY FROM HOT AND CHILLED WATER SYSTEMS WITH PRESSURES UP TO 150 P.S.I.

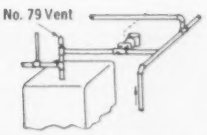
NO. 500 WATER VENT



This Hoffman Disc type valve vents all systems automatically! Adjusts for manual, steam or hot water venting. Valve can be cleaned of leak-sealing compounds or minerals without draining the system. Hygroscopic Fibre Discs automatically open to allow air to vent, close against steam or water. Selector screw controls venting rate. Size conn.: ⅛". Max. wtr. press.: 50 P.S.I.

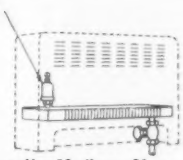
NO. 79 WATER VENT

WILL WITHSTAND HYDROSTATIC PRESSURES OF 200 P. S. I.



Designed for use on hot or cold water mains and process applications, this Hoffman Water Vent positively removes air from the piping of any water system. Tapped at top for ¼" I.P.S. safety drain connection for discharging moisture entrained in the vented air. Size conn.: ¾" Male, ½" Female. Max. oper. press.: 75 P.S.I.

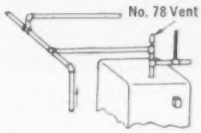
NO. 790 WATER VENT



A typically fine quality Hoffman Vent Valve especially designed for venting convectors, baseboard and wall radiation. Assures positive venting and continuous removal of air from system. If dirt should lodge between pin and seat, cap can be tightened down to prevent spitting until valve is cleaned. Safety drain connection at top for discharging moisture entrained in the vented air. Fitting and Ferrule for ⅜" O.D. tubing. Size conn.: ⅛". Max. operating press.: 30 P.S.I.

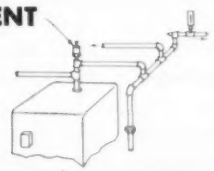
NO. 78 WATER VENT

WILL WITHSTAND HYDROSTATIC PRESSURES OF 450 P. S. I.



This Hoffman Valve is designed for use on high pressure hot or cold water mains and process applications. Automatically vents air from all water systems. Cast Brass Body. Safety drain connection for discharging moisture entrained in the vented air has fitting and ferrule for ¼" O.D. tubing. Size conn.: ¾" Male, ½" Female, Max. operating press.: 150 P.S.I.

NO. 791 WATER VENT



For continuous venting on convectors and small mains where operating pressure does not exceed 50 P.S.I. all brass body and fittings. This Hoffman Valve can be easily taken apart for cleaning or removal of dirt or compounds. Safety drain connection at top (has Fitting and Ferrule for ⅜" O.D. tubing for discharging moisture entrailed in the vented air.) Base conn.: ¼". Max. operating press.: 50 P.S.I.

OTHER HOFFMAN WATER SYSTEM SPECIALTIES

No. 150 High Head Circulators

No. 193 Circulator Valves

No. 201 Vent Tees

No. 1500 Air Separators "Swirlvent"

No. 250 Expansion Joints

No. 220 Expansion Tanks

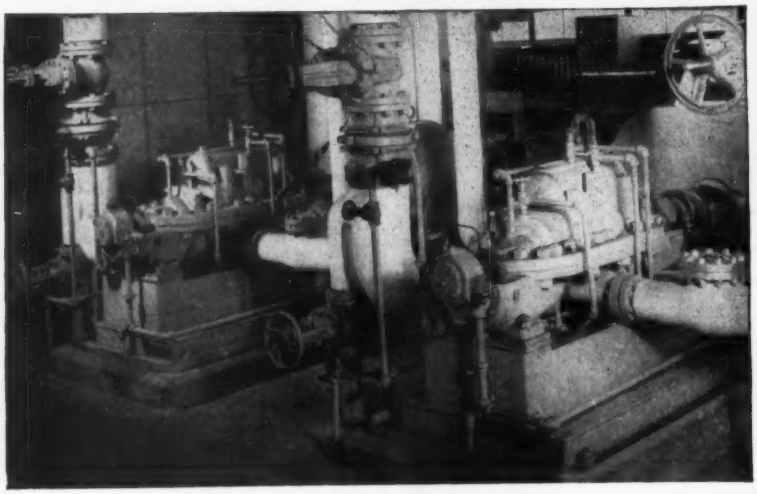
SOLD ONLY THROUGH LEADING WHOLESALERS OF HEATING AND PLUMBING EQUIPMENT

Write for Hot Water Catalog No. HW-855

HOFFMAN SPECIALTY MFG. CORP. 1700 W. 10th Street, Indianapolis 7, Indiana

PRODUCTION CONTINUITY

Begins in the Boiler Plant



Warren Six Stage Boiler Feed Pumps installed
at a Southern Board and Paper Mill.

Boiler Feed Pumps may look much alike, type for type, but it is well to keep in mind such intangible factors as:

- Experience and integrity of the manufacturer
- Dependability of product
- Know-how, Workmanship, Service
- Maintenance and Repairs
- Lost production due to down-time
- Early replacement because of "tight" original recommendations

It is impossible, of course, to get these items into your "specs," or the supplier into his "quotes," but don't overlook their importance with relation to price, possible future requirements and *production continuity*.

P-34

SEND FOR FREE BULLETINS

WARREN PUMPS, INC.

WARREN
MASSACHUSETTS

APPOINTMENTS

Corporation executive changes

Graver Tank & Mfg Co, Inc: E N Gosselin, chairman of board; J E Swanson, president. **The Bird-Archer Company:** Charles W Bird Jr, president. **General Nuclear Engineering Corporation:** John M West, vice-president. **International Boiler Works Company:** Georg Stabenow, vice-president, engineering. **Henry Pratt Company:** W J Woolley, executive vice-president. **Combustion Engineering, Inc:** Arthur J Santry Jr, vice-president and director. **Technology Instrument Corporation:** Hollis L Gray Jr, vice-president.

Walworth Company: George E McDonald, vice-president and treasurer, John C Wallace, vice-president, engineering; Frederick M Jackson, vice-president, sales. **Robertshaw Fulton Controls Company:** John A Robertshaw Jr, vice-president. **Riley Stoker Corporation:** Robert K Griffith, vice-president, treasurer and director. **Norden-Ketay Corporation:** Bernard Levine, vice-president. **Iron Fireman Manufacturing Company:** Orval D Berry, vice-president. **Copeland Refrigeration Corporation:** M W McLaughlin, vice-president, manufacturing.

Engineer changes

Bailey Meter Company: John F Luhrs, staff engineer in special products division. **Security Engineering division,** one of the Dresser Industries: M L Talbert, chief engineer. **Panellit Inc:** Wendell H Neeley, project engineer, West Coast plant. **The Babcock & Wilcox Company:** Michael Parahus Jr, assistant chief electrical engineer, tubular products division. **Harbison-Walker Refractories Company:** Charles D Gabor, assistant chief engineer. **General Electric Company:** Bernard J Alperin, development engineer, applied research and development laboratory, foundry department.

Seelye Stevenson Value & Knecht: Williams D Bailey, associate, civil engineering division; Frohman P Davis, Ira M Hooper, Frederick J Kircher, Philip P Page, Wayman C Wing, associates, structural engineering division; William T Cleland, Jack N Keck, Alexander Michelson Jr, associates, mechanical and electrical division.

New sales managers

Orr & Sembower, Inc: Paul E O'Hora, New York district. **Wolverine Tube,** division of Calumet & Hecla, Inc: Albert R Kaspark, technical sales. **National Aluminate Corporation:** Loren Pollet, Chicago district. **Canton Stoker Corporation:** J C Fosselman, stoker division. **Kelman Electric & Manufacturing Company:** Robert F Schall. **Harbison-Walker**

Tough Expansion Joint Problem?

Put the Badger Man on the Spot!

Complex expansion joint problems are *best* analyzed at only one place: your office or plant site. It's there alone — where the figuring is going on — that *all* essential data about your proposed installation is available.

And it's there — *on the spot* — that the Badger Man can assist you. Because 1. he is a trained engineer; 2. he brings to your problem the background of the world's most experienced manufacturer of expansion joints.*

Next time you are confronted with a complicated piping layout, severe operating conditions, unusual size and shape requirements — *any* complex expansion joint problem — put the Badger Man on the spot! His services are as close as your telephone.

COMING SOON — Badger Service-Rated Expansion Joints. Incorporate revolutionary new features developed during three years of intensive research and testing. Watch for this important announcement.

* Badger has been solving tough expansion joint problems for 50 years — a record unmatched by any other firm.

BMC

BADGER EXPANSION JOINTS

BADGER MANUFACTURING COMPANY

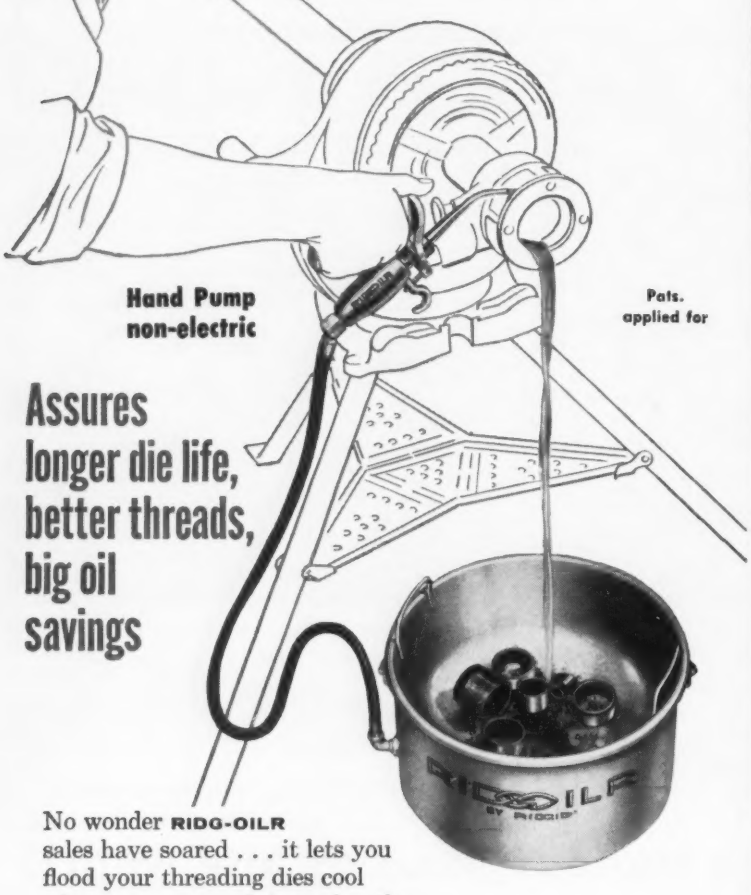
230 Bent Street, Cambridge 41, Massachusetts • 60 East 42nd Street, New York 17, New York

Representatives in principal cities

Handy New Portable

RIDGOILR

gives you plenty of oil wherever you thread pipe



Assures longer die life, better threads, big oil savings

No wonder **RIDG-OILR** sales have soared . . . it lets you flood your threading dies cool wherever your work is, makes them cut better threads, last longer. Consists of screened chip-pan in circulating oil reservoir with hose-connected hand pump-gun, easy to operate—light to carry. Oil is double strained, used over and over. No messy floors. Quickly pays for itself—buy it at your Supply House!

The Ridge Tool Company • Elyria, Ohio, U.S.A.

RIDGID
Work-Saver Pipe Tools

More APPOINTMENTS

Begins on page 244

Refractories Company: Howard G Hart, St. Louis district. **Warner Electric Brake & Clutch Company:** Roger H Brown, industrial division.

American Blower division of American-Standard: Richard C Walsh, Green Bay, Wis, branch. **The H M Harper Company:** William O'Dell, Atlanta branch. **Johns-Manville Corporation,** pipe division: Jack W Davis, Rocky Mountain region.

New district offices

Sylvania Electric Products Inc, lighting division: at 244 Mineola Boulevard, Mineola, N. Y., Edward H Furbank, manager. **NRC Equipment Corporation:** at 19185 James Couzens Highway, Detroit 35, Mich., William C Long, manager. **The Babcock & Wilcox Company,** tubular products division: at 830 W Peachtree NW, Atlanta 8, Ga., William Lehr, manager.

New distributors

For **Westinghouse Electric Corporation,** Sturtevant division: Neal T O'Rourke & Associates, Buffalo, N. Y. For **Parker Appliance Company:** Allied Precision Components Corporation, 20 Park Ave, Mount Vernon, N. Y., and Industrial Piping Supply Corp, 705 N 22nd St, Bessemer, Ala. For **United States Gauge,** division of American Machine and Metals, Inc: Truesdell Company, 790 S Broad St, Newark, N. J., and The Ray Welch Company, 6346 Columbia Ave, Hammond, Ind. For **R G LeTourneau, Inc:** Benkart Steel & Supply Co, 4th Ave and Thorn St, Coraopolis, Pa.; John J Connell Co, Inc, 3014 Olive St, St. Louis 3, Mo.; Hallidie Machinery Co, 210 Hudson St, Seattle, Wash.; and Wm H Ziegler Co, Inc, 2929 University Ave SE, Minneapolis 14, Minn. For **Warner Electric Brake & Clutch Company,** industrial division: Samuel Harris & Co, Inc, 114 N Clinton St, Chicago, Ill.

New representatives

For **Conoflow Corporation:** Brown & Morrison, Charlotte, N. C. For **Wolverine Tube** division of Calumet & Hecla, Inc: Howard J Luetzow, 1580 Sherman St, Evanston, Ill. For **Cleaver-Brooks Company:** Norbert W Enslen Company, 1987 William Lane, Dayton 9, Ohio. For **Bros Incorporated:** D H Skeen and Company, 1 N LaSalle St, Chicago, Ill., and Yates Equipment and Supply Co, Ripon, Wis.

Recent purchases, mergers

Minnesota Rubber and Gasket Company: acquisition of assets of General Industrial Products Company, Inc. **Consolidated Diesel Electric Corporation:** acquisition by a wholly-owned

SOLID WHEEL

spells non-stop turbine performance

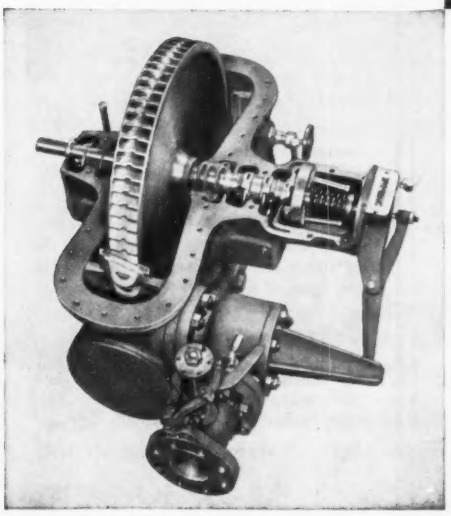
It's easy to see why Terry solid-wheel turbines have been setting non-stop records. They're built for long periods of continuous service.

The rotor, for example, is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out.

What's more, the blades can't foul. There is a one-inch clearance on either side of the wheel and the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets at right angles to the shaft.

You, too, can profit from Terry solid-wheel stamina. Bulletin S-116 gives full details. Send for a copy today.

THE TERRY STEAM TURBINE CO.
Terry Square, Hartford 1, Conn.



Action of steam in a Terry solid-wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

TT-1205

TERRY

EXTRA YEARS

OF MORE DEPENDABLE POWER

and at less cost per pound of steam

TODD BURNERS

GAS OR OIL

PRODUCTS DIVISION

TODD SHIPYARDS CORPORATION

HEADQUARTERS:

Columbia & Halleck Streets, Brooklyn 31, N. Y.

PLANT:

Green's Bayou, Houston 15, Texas

TODD NEW YORK, U.S.A.

Write for....Power's REPRINT FOLDER

. . . giving SUMMARIES and PRICES on

Power's information-packed

SPECIAL REPORTS

"the most useful condensed handbooks in the power and plant service field."

POWER, 330 West 42nd Street
New York 36, N. Y.

Gentlemen: Please send me a copy of Power's "Reprint Folder".

Name.....

Address.....

City & State.....

More APPOINTMENTS

Begins on page 246

subsidiary of the business and assets of The Lima Electric Motor Company. **Olin Mathieson Chemical Corporation:** completed negotiations for purchase of assets of Southern Electrical Corporation, subject to approval of Southern Electrical stockholders. **Minneapolis-Honeywell Regulator Company:** acquisition of all stock of Davies Laboratories, Inc. **Simpson Electric Company,** parent company American Gage & Machine Co; acquisition by parent company of Standard Transformer Company.

Institute elections

Cooling Tower Institute: Paul R Hoffmann, president; Karl E Johnson, vice-president; Denis E O'Neil, secretary; Forrest B Reed, treasurer. **Hydraulic Institute:** Noble Dean Jr, president; Wayne Staley, vice-president. **Hoist Manufacturers Association, Inc:** Arland R Walkley, president; Milton L Aitken, vice-president; Joe H Peritz, executive secretary and treasurer.

New names

Jensen, Incorporated: formerly known as Jensen Specialties, Inc. **Betz Laboratories, Inc:** formerly known as W H & L D Betz Company.

Retirements

George T Naff, vice-chairman of the board of Texas Eastern Transmission Corporation. Mr Naff, who has been with the company virtually since it was founded in 1947 and served as president for almost three years, will serve as a consultant to Texas Eastern and others on oil and gas matters.

Charles F Radley, one of the original directors of Oakite Products, Inc, has retired from active duty as director of publicity and member of the board. He is continuing service as a consultant.

Louis Rove, district manager of Norberg Manufacturing Company's Great Lakes territory, after more than 35 years of service to the company.

Stewart L Ferguson, treasurer of The Detroit Edison Company, after more than 43 years of service to the company.

John S O'Gorman Jr, manager of Detroit branch of Johnson Service Company after 26 years of service to the company. He will continue to serve on the board of directors.

Obituaries

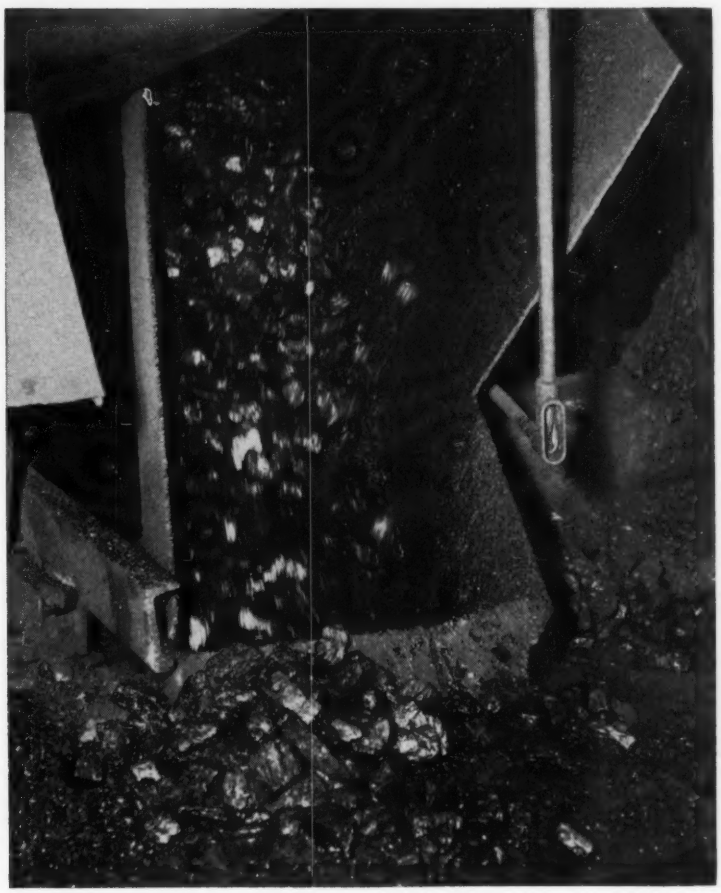
Ira Emmett McCabe, chief engineer and chairman of the board of The Mercoid Corporation, on February 13th.

Ernest P Irany, 61, member of the research and development department of the Norton Company, on January 11th.

IN COAL-HANDLING SYSTEMS

LONGER SERVICE-LESS MAINTENANCE

where USS "T-1" Steel is being used!



Listen to coal rumble, scour, and scrape down a chute . . . bang into a hopper. Imagine the impact and abrasion generated by ton after ton after ton of it. You'll realize why it takes an extraordinary steel to give long service without repair in coal-handling equipment. And you'll realize why USS "T-1" Steel is becoming standard for such service.

For maximum resistance to impact abrasion, USS "T-1" Steel is furnished hardened to 321 minimum Brinell. In this condition, it assures the durability to minimize maintenance and repair costs. And it often permits use of thinner gages to save weight, material, and to cut the cost of supporting structures and foundations.

And here's the clincher. USS "T-1" Steel can be welded in the field without pre- or post-heating. This is unique in a steel so strong and durable. It means on-the-spot fabrication at minimum cost.

Also remember "T-1's" remarkable toughness, even at sub-zero temperatures. Outdoors and indoors, "T-1" assures long life, minimum repair.

In electric power plants . . . in coal preparation plants . . . in strip and underground mines, USS "T-1" Steel not only can cut your costs but also can improve the performance of your coal-handling systems. It's service-tested. Write, wire or phone our nearest District Sales Office for complete information.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION • WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

"USS" and "T-1" are registered trademarks.

Watch the **United States Steel Hour** on TV every other Wednesday (10 p.m. Eastern time).

UNITED STATES STEEL

The Inside Story of

CHAPMAN

Motor Units

For Valves, Floorstands and Sluice Gates

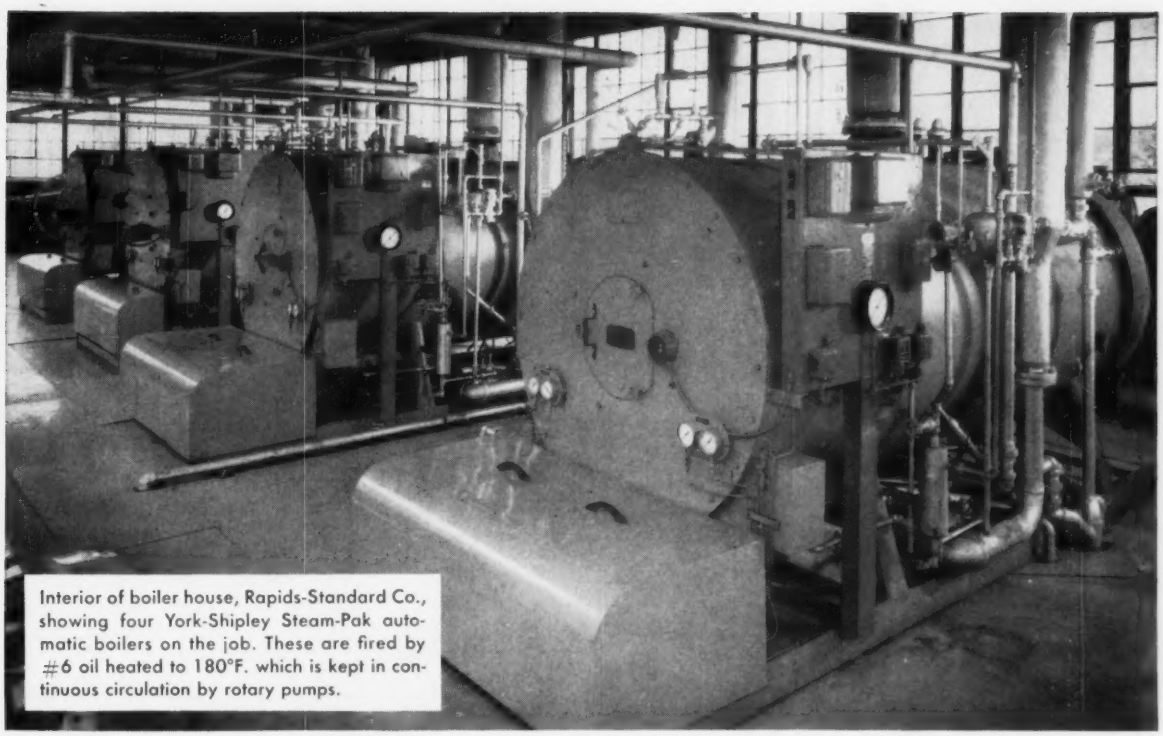
The exposed view gives you the facts. On a Chapman Motor Unit there are approximately half as many parts as with any other make. This is engineering sense. The fewer the parts the fewer the headaches. The less complicated the unit the less you pay for maintenance.

This simplification in design is all on your plus side. You lose nothing in performance. In fact you get smooth accurate performance over a *longer* period of time. There's no drift. Backlash is low. And seat tightness is held at any predetermined level by precise micrometer-controlled limit switch.

Installation is easy and economical. When used with floorstands they come completely wired at factory . . . ready for your line. They're weatherproof. They're *steam tight*. And they operate at any angle. Rugged stub-tooth gears require no grease or oil.

See our Catalog 51, now. If you've misplaced your copy write for a new one, today.

THE CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASSACHUSETTS



Interior of boiler house, Rapids-Standard Co., showing four York-Shipley Steam-Pak automatic boilers on the job. These are fired by #6 oil heated to 180°F. which is kept in continuous circulation by rotary pumps.

They're saving money today . . . and looking after tomorrow, too!

How York-Power Steam-Paks more than doubled heating output . . . with no increase in building costs.

For more than eight years, two YORK-POWER Steam-Paks had been supplying ample heat for the Rapids-Standard Company in their Plymouth, Michigan plant.

The efficiency and economy records of these boilers were so high that when the time came to double plant facilities, company engineers realized they could do no better than to add two more Steam-Paks to take care of increased heating needs.

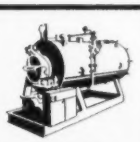
"From our particular view point," said Mr. Russell A. Inwood, Vice President of Engineering and Manufacturing, "the flexibility which YORK-POWER Steam-Paks provided for continuous expansion was of greatest importance. Also, because there were no expensive chimneys or foundations to construct, and because the units were pre-wired and pre-piped, we could cut down on installation costs."

SAVED BUILDING COSTS. Merely by rearranging the floor plan of the over-size boiler house, it was found that two more Steam-Paks could be set up . . . with *no extra building costs.* These four units now take care of all present heating needs and also provide for continued expansion for many years to come.

Find out how YORK-POWER Steam-Paks can help you. Our engineers are available to give full cooperation. Specification sheets and detailed data are yours for the asking. Write TODAY.

Industrial Division **YORK-SHIPLEY, Inc.** YORK, PENNSYLVANIA

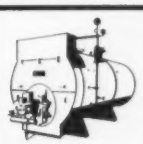
ONLY YORK-POWER OFFERS A COMPLETE LINE OF AUTOMATIC BOILERS, BURNERS, AND FUEL BURNING SYSTEMS



STEAM-PAK
15 to 600 Hp.
Oil and/or Gas Firing

STEAM-PAKETTE
10 to 50 Hp.
Oil and/or Gas Firing

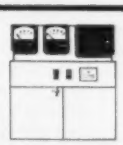
FIRE-PAK
35 to 485 Hp.
Oil and/or Gas Firing



SCOT-PAK
52 to 400 Hp.
Oil and/or Gas Firing

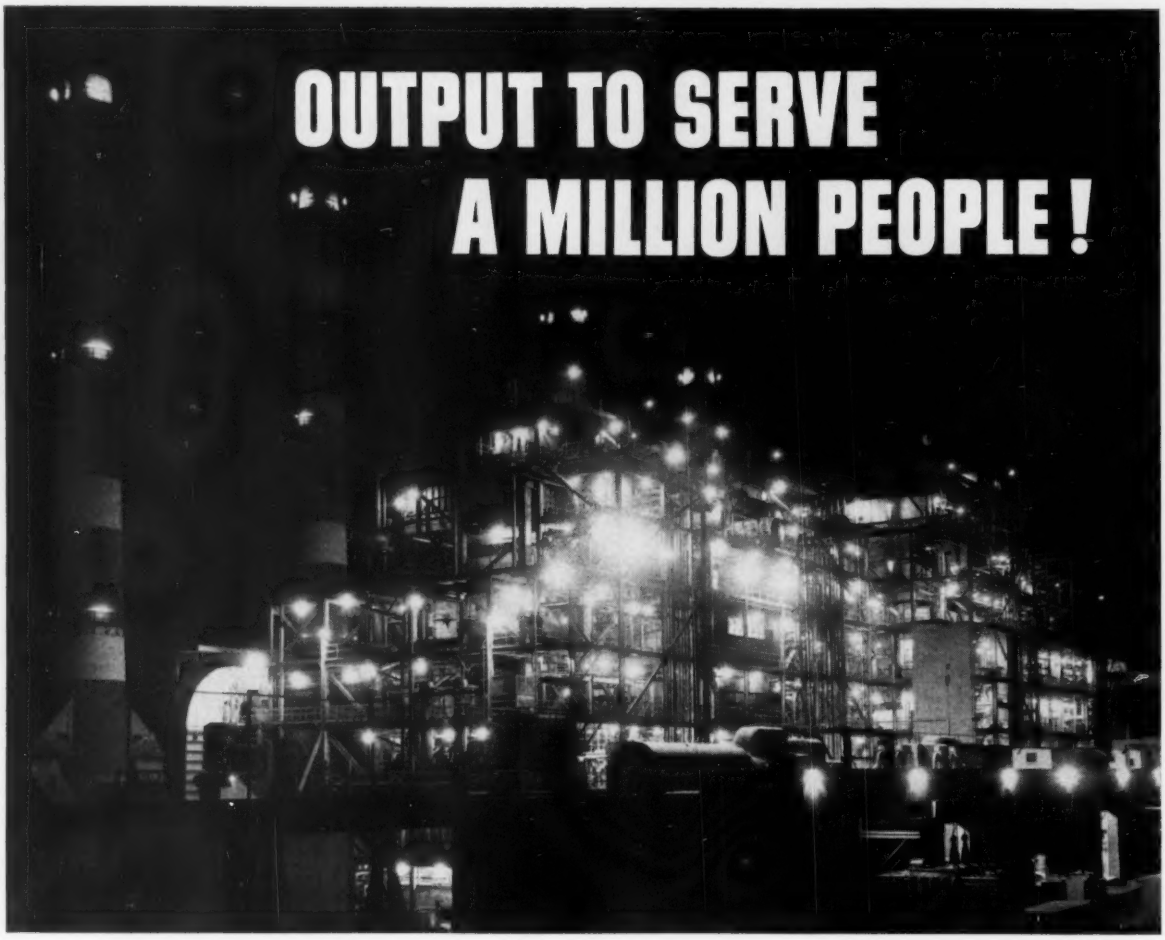
ECONOL BURNER
5 to 28 G. P. H.
Oil Firing

ROTARY BURNER
18 to 400 Hp.
Oil and/or Gas Firing

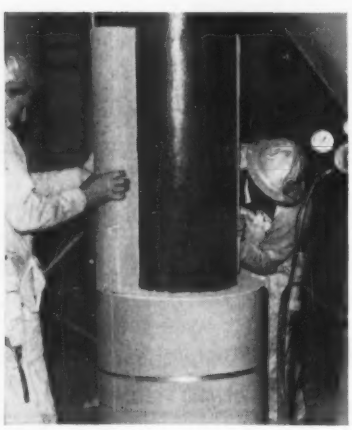


F/C SYSTEMS
Automatic Fuel Burning Systems

OUTPUT TO SERVE A MILLION PEOPLE!



from closed-circuit television to **UNIBESTOS** *pipe insulation . . . one of the West's most modern*



Single-layer **UNIBESTOS** locks in more heat than most double-layer insulations. It resists shock, vibration, and chemical fumes—doesn't shrink to expose pipe to heat loss. Sizes to 44" o.d. Ask for UNARCO'S free 40-page booklet with exclusive "J" Factor Tables.

This is the new $80,000,000.00 Valley Steam Plant of the Los Angeles Department of Water and Power, latest addition to municipal steam electric generating facilities which, today, supply more than three-quarters of the city's electricity requirements. In 1941, 95% came from hydroelectric sources.

Valley Steam Plant is big and efficient, with a generating capacity of 512,000 kilowatts. It has about 1700 control switches, instruments, and relays; 761 miles of control wire and power cable; 605 electric motors ranging in size up to 2250 h.p. and – of course – UNIBESTOS® Pipe Insulation throughout, aluminum-jacketed where exposed to the elements.

Closed-circuit television, with six screens in each control room, keep watchful eyes on flames and water levels. Automation is a progressive reality here. And modern UNIBESTOS, on piping from 140 to 1000°F., gives further proof of the careful planning that went into this outstanding project.

UNIBESTOS also is used by the Los Angeles Department of Water and Power at the Harbor Steam Plant, by major power plants the country over . . . by petroleum and chemical processors, atomic developments, and modern industry for dependable conservation of energy.

UNARCO®

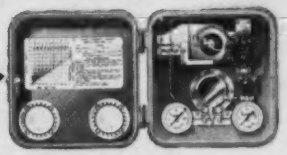
UNION ASBESTOS & RUBBER COMPANY

1111 West Perry Street, Bloomington, Illinois

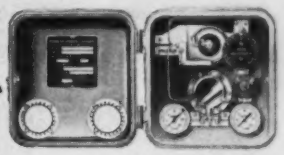
FISHER®
LEVEL-TROL

The Answer to Your Liquid Level Needs

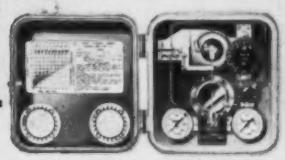
TYPE 259B—Level-Trol cage unit with 2" 600 lb. flanged top and bottom equalizing connections (F-1).



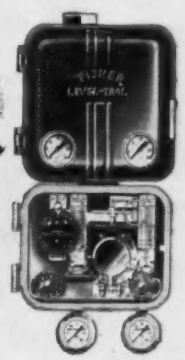
TYPE 2500—proportional pilot for general liquid level control applications.



TYPE 2500T — Level-Trol pilot used as pneumatic level transmitter.



TYPE 2500C—pilot with level indicator. Indicator available on all style Level-Trol pilots.



TYPE 2500 — 2516 dual Level-Trol pilot consisting of Type 2500 for remote level-indication or recording and Type 2516 controller with proportional and reset response.

The wide variety of pilots available for mounting on the Level-Trol gives further evidence of the Level-Trol's ability to handle practically any liquid level, interface level, or specific gravity control or indication problem.

FISHER GOVERNOR COMPANY

MARSHALLTOWN, IOWA • WOODSTOCK, ONTARIO

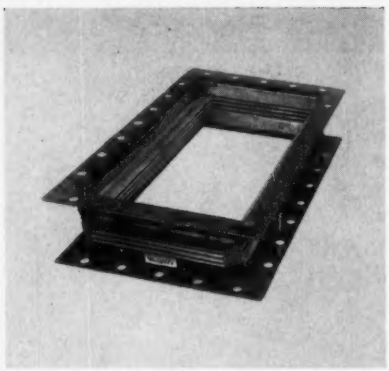
WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER *Since 1880*

SOLA FLEX®

THE FINEST IN EXPANSION JOINTS AND BELLOWS

MADE IN ALL SIZES AND VARIETIES



THE SOLA-FLEX LINE is the most comprehensive in the world. It includes many basic types of expansion joints—convoluted, U-span, rectangular, and others. Sizes range from ½ in. to 35 ft in diameter. Pressure ranges run from complete vacuum to 3500 psi, and bellows have been built for service from—300 F to 2000 F. Materials used include all types of steels and a variety of high alloys.

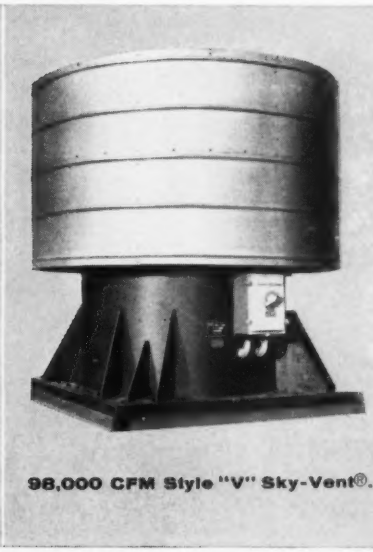
Pipe expansion problems increase with higher pressures, temperatures and smaller space. Sola-Flex joints provide the answer—with economy and efficiency. Write for catalog today. Dept. D-20, Solar Aircraft Company, San Diego 12, California.

SOLAR AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

Designers, Developers and Manufacturers • Gas Turbines • Aircraft and Missile Components • Bellows • Controls • Coatings • Metal Alloy Products

THREE PRACTICAL WAYS

84" 100,000 CFM Style "H" Sky-Vent®—one of four on power plant.



98,000 CFM Style "V" Sky-Vent®.

Combination Package—Winter Makeup Air Supply and Summer Exhaust.

TO VENTILATE AND/OR HEAT A BOILER ROOM—

"BUFFALO" PACKAGE ROOF VENTILATORS — "Buffalo" Sky-Vent® Power Roof Ventilators provide efficient, high-volume exhaust of large room areas. They take advantage of heat rise and require no ductwork. Complete, ready-to-install units with inlet, curb plate, stack and hood — rigid, sturdy and weatherproof. Write for Bulletin FM-2345.

FOR MAKEUP AIR — where fresh, heated air is needed to replace large quantities of air removed from the boiler room by the forced draft fans, "Buffalo" Propeller Fan Makeup Air Package Units offer an economical solution. These consist of non-freeze finned steam coils and high-capacity propeller fans in easy-to-install units — available, too, with filtered intake and by-pass dampers for economical summer cooling. Write for recommendations on your requirements.

"BUFFALO" PACKAGE PROPELLER FANS — These are heavy-duty units, delivered ready to mount in window or wall openings and start exhausting excess heat against pressures up to 1". Their high-efficiency 4-blade design permits slow-speed operation for low noise level and long life. In 24" to 120" sizes to give you capacities clear up to 250,000 cfm, "Buffalo" Package Propeller Fans are proving the most satisfactory answer for ventilating many large boiler rooms, both from the economy and the performance standpoints. Have us mail you Bulletin FM-2345.

The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

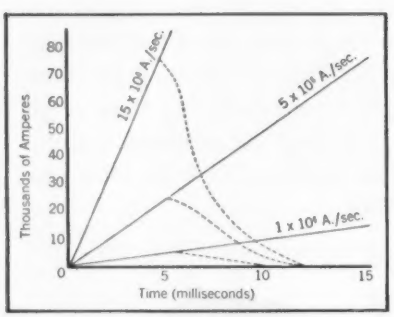
INDUSTRIAL EXHAUSTERS BELTED VENT SETS PROPELLER FANS "E" BLOWERS — EXHAUSTERS

D-C CIRCUIT BREAKERS

Type FB-20 single pole circuit breaker; 2000 amperes continuous, 1000 volts d-c.

NEW "FB" CURRENT LIMITING CIRCUIT BREAKER

Now...complete current limiting protection against fault currents of 1000 to 150,000 amperes



Peak let-through current for FB circuit breaker with 1000 ampere trip.

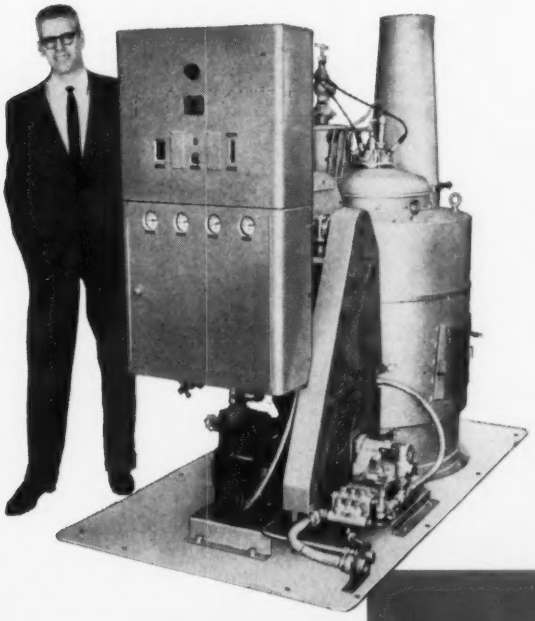
Small in size, these FB d-c circuit breakers with fast current limiting action provide a tremendous protective capacity. In the event of a fault, powerful springs open the contacts before the current has a chance to rise to its maximum potential.

Even in circuits where the rate of rise might approach 15,000,000 amperes per second, let-through current will not exceed 80,000 amperes. In most applications, it will never exceed 30,000 amperes—and total interrupting time is only 12 milliseconds. This quick action reduces the magnitude and duration of fault currents—thus eliminating mechanical failures and heat damage.

FB circuit breakers are available in either single or double pole models and with continuous current ratings of 1200, 2000, 3000 and 5000 amperes and up to 1000 volts d-c. They are available with either stationary or drawout mounting. Write for Bulletin 3004-A. I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

IN CANADA: EASTERN POWER DEVICES LTD.



don't use floor space for your boiler room

VAPOR MODULATIC

WATER TUBE BOILER

you can put it on the roof— on a balcony—or hang it from the ceiling

PAY FOR YOUR STEAM THRU FLOOR SPACE SAVED!

OVER 13,000 SATISFIED USERS

produces up to 4 h.p. per sq. ft. of area

- Develops up to 27 H.P. per 1000# of weight.
- Produces up to .6 H.P. per *cubic ft.* of space used.
- Needs only 15" above top of boiler for maintenance. No additional floor space needed.
- Can produce 10% or more above ratings, continuously.
- Full ASME approved.
- It is a complete package unit.
- Proved by 25 years in America's toughest boiler rooms.

8 sizes: 10 to 160 H.P.
Pressures: 5 to 900 psig.

Write for complete specifications on the boiler that requires less space and permits lighter floor structure—The Vapor Modulatic.

VAPOR HEATING CORPORATION, 80 E. Jackson Blvd., Chicago 4

DEPT. 14-E

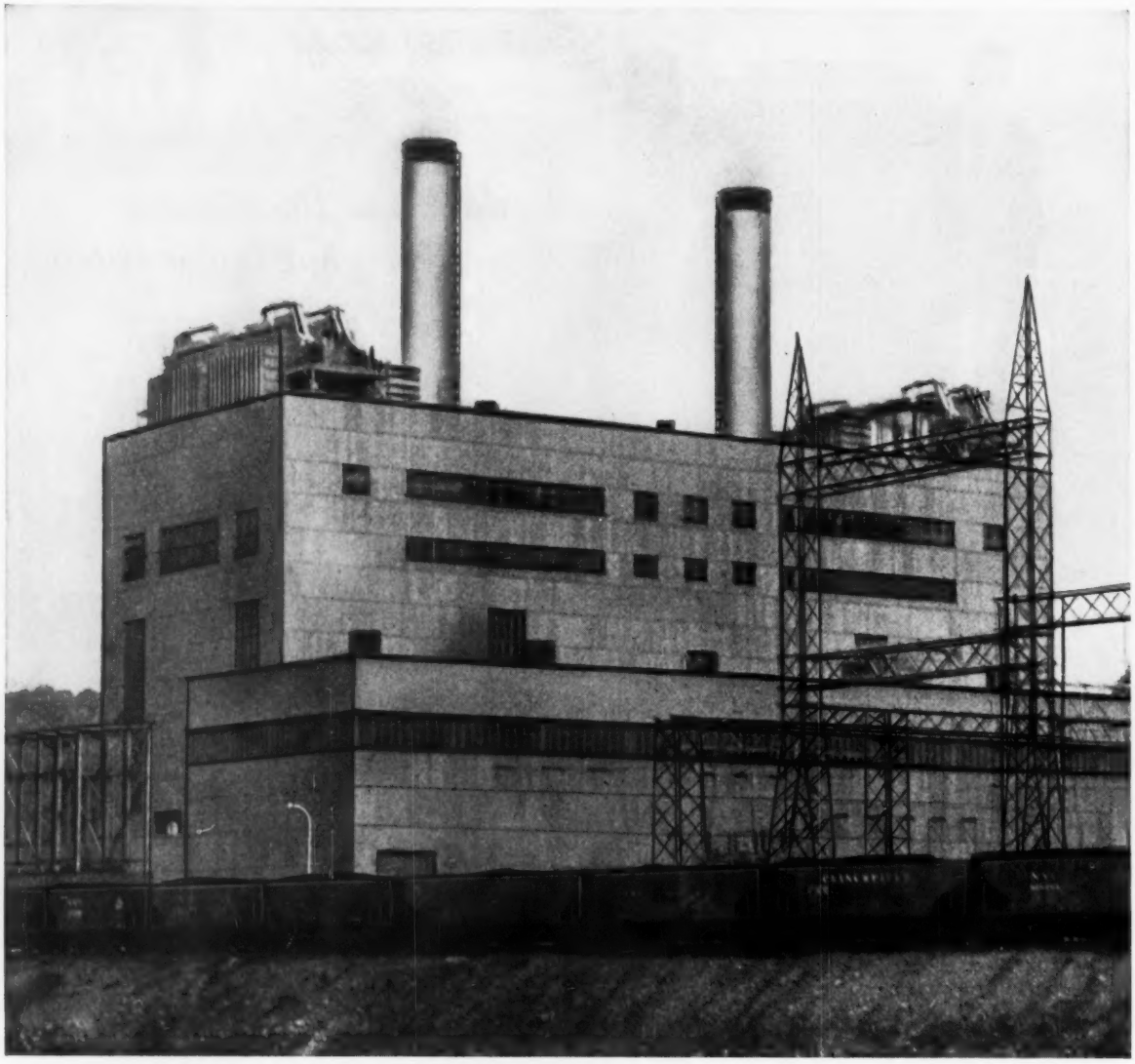
Send me Modulatic Bulletin No. 586.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____



LUMNITE-MADE CONCRETE for linings in stacks, ducts, ash hoppers, and other power plant installations provides years of trouble-free service. Above: Stacks at Pennsylvania Electric Company, Shawville, Pa., were gunite-lined with Lumnite-made concrete.

Greater resistance to heat and corrosion with stack linings of Atlas LUMNITE* cement

- Industrial concretes made with Atlas Lumnite cement give rugged resistance against heat, corrosion, abrasion and thermal shock.
- Repairs and downtime are reduced to a minimum.
- Placement is fast and easy—by pouring, plastering or guniting.

For maximum convenience, use Lumnite-made castables. These are pre-mixed, ready for use and are made and distributed by leading manufacturers of refractories.

For more information, write: Universal Atlas, 100 Park Avenue, New York 17, N. Y.

UNIVERSAL ATLAS CEMENTS

USS

* **"LUMNITE"** is the registered trademark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

L-150

UNIVERSAL ATLAS CEMENT COMPANY—member of the industrial family that serves the nation—**UNITED STATES STEEL**

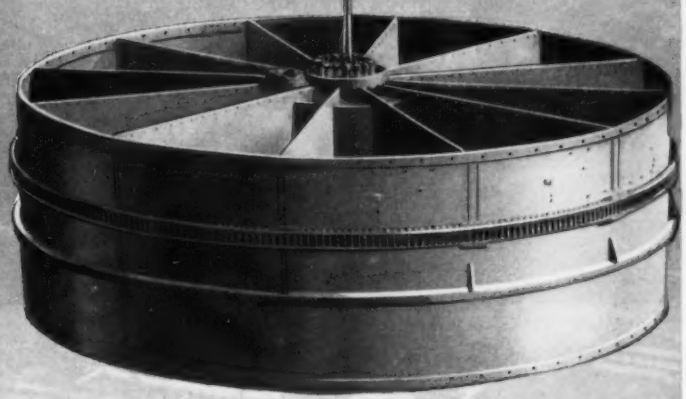
OFFICES: *Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco*

WHAT'S SPECIAL ABOUT LJUNGSTROM®

research and engineering

Air Preheater has made many important advances in gas-to-gas heat exchangers over the past 32 years. Some of the major developments of Air Preheater research are:

- The mass flow soot blower
- Multiple-layer heating surface
- Wide-spaced cold end heating surface



- Methods of cold end protection
- Use of alloy steel for cold end material
- Designs of more compact and effective heating surfaces
- Heat transfer surfaces replaceable during boiler operation
- Superheated steam for soot blowing

That's why seven out of ten air preheater installations are Ljungstrom. For the full story of its many advantages, write now for your copy of our 38-page manual.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

new!

NOW JOY BRINGS YOU THE WN-224... *Largest* "PACKAGE"-TYPE COMPRESSOR YET... UP TO 1000 HP

Here's a *new* approach to air compression in the 2418 to 6048 cfm range. Instead of long, heavy horizontal units resting on massive foundations, the Joy WN-224 has four cylinders arranged semi-radially around the frame. This compact, balanced arrangement assures smoother running, gives longer, longer service with far less maintenance.

Installation is greatly simplified—there is no assembling or aligning—just bolt it down, connect power, water and air lines—and you're ready for long, continuous service.

Joy has had years of experience with semi-radial design—pioneered it and proved it in hundreds of installations of the WN-114, a close cousin to this newer machine. Look over this specification chart . . . if you use compressed air in these volumes and pressures, you should find out more about the WN-224. Write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

WSW I-6607-174

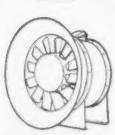
JOY ... EQUIPMENT FOR INDUSTRIAL PLANTS ... FOR ALL INDUSTRY

WRITE FOR FREE BULLETIN 174-16

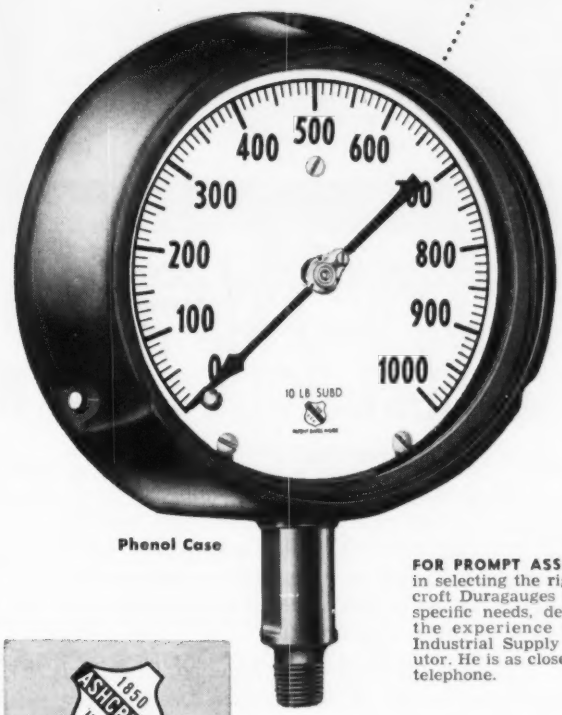
Industrial Compressors

Conveyors

Electrical Connectors


Fans and Blowers

Alumalife® Case



Phenol Case

FOR PROMPT ASSISTANCE in selecting the right Ashcroft Duragauges for your specific needs, depend on the experience of your Industrial Supply Distributor. He is as close as your telephone.

Why do ASHCROFT DURAGAUGE CASES increase service life?

Duragauge casings add extra-long service life to Duragauges because they're available in three different materials: you can choose the case-material that stands up best in *your application.* You have a choice of *Alumalife®* – a special aluminum alloy; *Cast Iron,* rugged and durable; and *Phenol,* a tough, rigid plastic.

Duragauge casings are dust and moistureproof. Chrome-plated, die-cast retaining rings keep the dial cover glass tightly in position and prevent the entrance of dirt or harmful fumes. Depending upon material, casings are Bonderized and the ring is Anodized and dichromate sealed for protection from corrosion.

For added protection, there is the Maxisafe Duragauge casing with a solid front – a special design for maximum safety and ease of maintenance. Duragauges are easy to service since Duragauge casings are constructed so that the entire system – socket, tube, tip, movement, dial and pointer – can easily be removed as a unit.

Lifetime Duragauge cases are available for numerous dial sizes. You have a choice of Bourdon tube materials, a wide range of pressures, and a movement made completely of stainless steel or stainless steel with nylon bearings and pinion gear.

Whatever case material and gauge system is best for your needs, you can rely on the Ashcroft Duragauge for highest sustained accuracy and long service life.

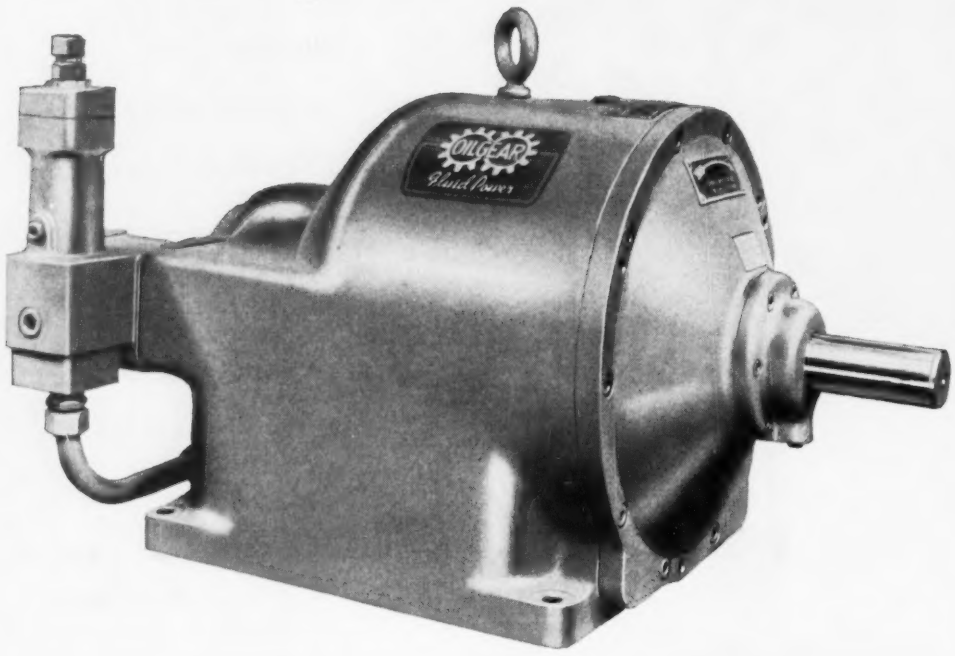
In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

G4-56



OILGEAR CONSTANT AND VARIABLE DELIVERY PUMPS. Sturdy, compact units built in sizes having normal ratings from 4 to 150 hp. For over 5 years, Cellulubes kept the durability of these pumps high, even on constant pressure applications.

Where a fire-resistant lubricant is a must—

Celanese Cellulubes give you the plus feature of excellent lubrication . . .

More and more equipment manufacturers and lubrication engineers are learning that fire-resistant Cellulube lubricants provide superior protection against excessive wear during continuous operation under extreme pressures. Tests conducted by The Oilgear Company of Milwaukee, Wisconsin on various fire-resistant fluids showed that Cellulubes "seem to be the most satisfactory fluids for use in Oilgear pumping equipment."

Cellulubes are straight phosphate ester base synthetic oils . . . chemical compounds that contain no additives. Because of this, and because of lower flammability and reduced tendency to form undesirable deposits, Cellulubes can provide excellent lubrication combined with dependable fire protection.

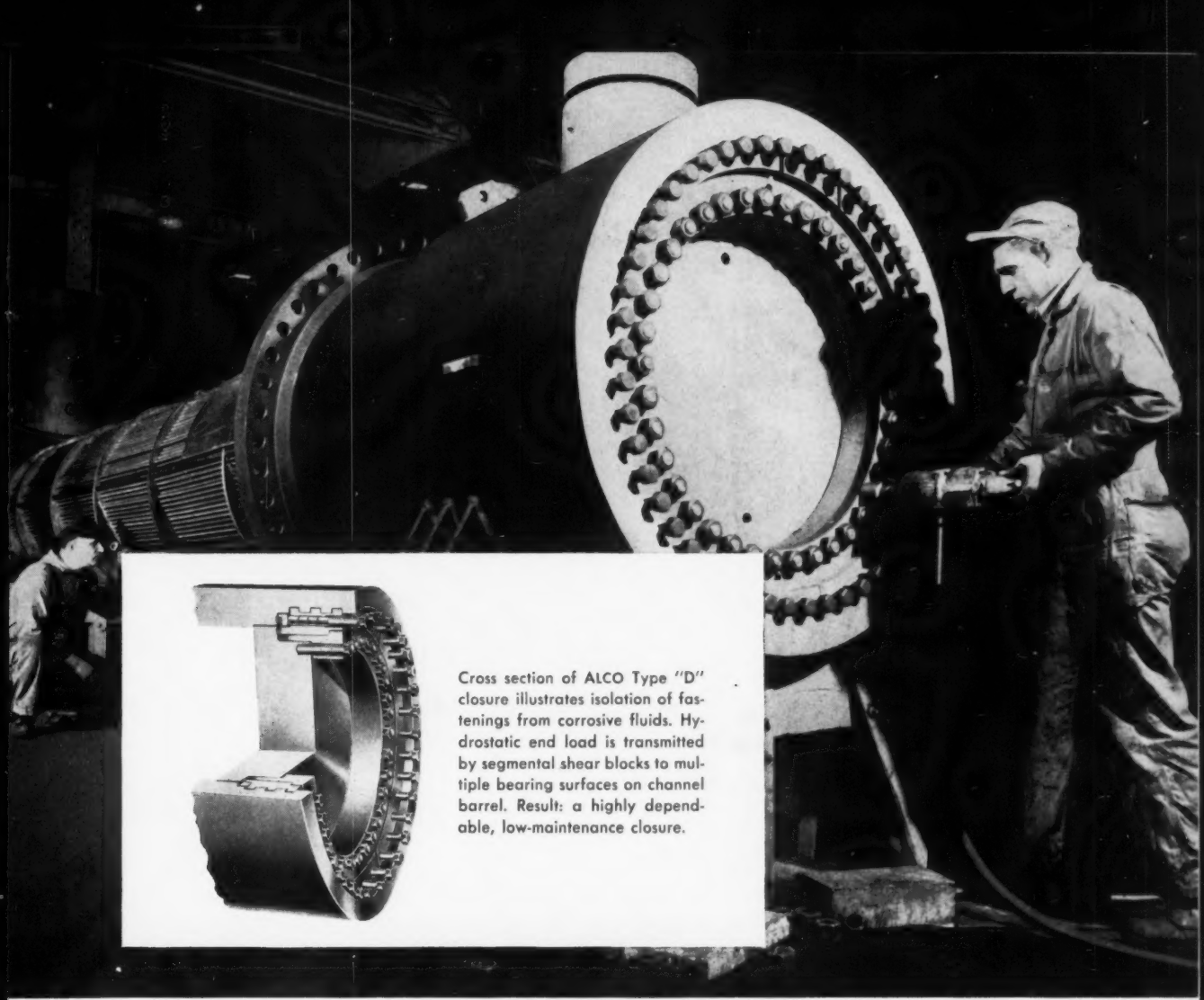
Cellulubes are available for supply in 6 controlled viscosities to meet exacting requirements in the replacement of flammable lubricants presently in use in your plant or equipment. Write for working samples and complete data for a thorough evaluation.

Celanese Corporation of America, Chemical Division, Dept. 597-E, 180 Madison Avenue, New York 16, N. Y.

Celanese® Cellulube®

Celanese CHEMICALS

In Canada: Canadian Chemical Co., Limited, 2035 Guy Street, Montreal, P. Q., Canada
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y.



Cross section of ALCO Type "D" closure illustrates isolation of fastenings from corrosive fluids. Hydrostatic end load is transmitted by segmental shear blocks to multiple bearing surfaces on channel barrel. Result: a highly dependable, low-maintenance closure.

PROVED TYPE "D" CLOSURE PUTS EXTRA VALUE IN ALCO HIGH-PRESSURE FEEDWATER HEATERS

Mechanical locking arrangement makes tubes easily accessible without cutting or welding; closure can be easily dismounted and reassembled with hand tools

The ALCO-developed Type "D" high-pressure closure, standard on all ALCO high-pressure feedwater heaters, adds extra savings in operation and maintenance to these units. Its mechanical design permits access to the tubes without cutting open the closure and then doing expensive rewelding. Demounting and reassembly can be accomplished in a single shift—with significant savings in equipment down time.

The Type "D" closure is completely dependable. Extensive service in the country's largest steam-generating plants has proved its operation. Locking components and screwed fastenings are not contacted by the contained condensate, assuring easy disassembly of the cover. The screwed fastenings carry no hydrostatic end load so the gasket seal is not affected by fluctuating pressure.

It's another benefit of installing ALCO feedwater heaters in your plant. For years the toughest feedwater heating problems have been assigned to ALCO. Proof that ALCO has solved them is now in the country's largest high-temperature, high-pressure steam plants. ALCO evaporators, with their patented "Flextube" scale-shedding construction, are also proving their reliability and economy.

If you'd like more facts, we'll be happy to send you our Bulletins FH-2 and EV-1. They give complete details. Simply write Thermal Products Division, Dept. FHE-1, P.O. Box 1065, Schenectady 1, N. Y.

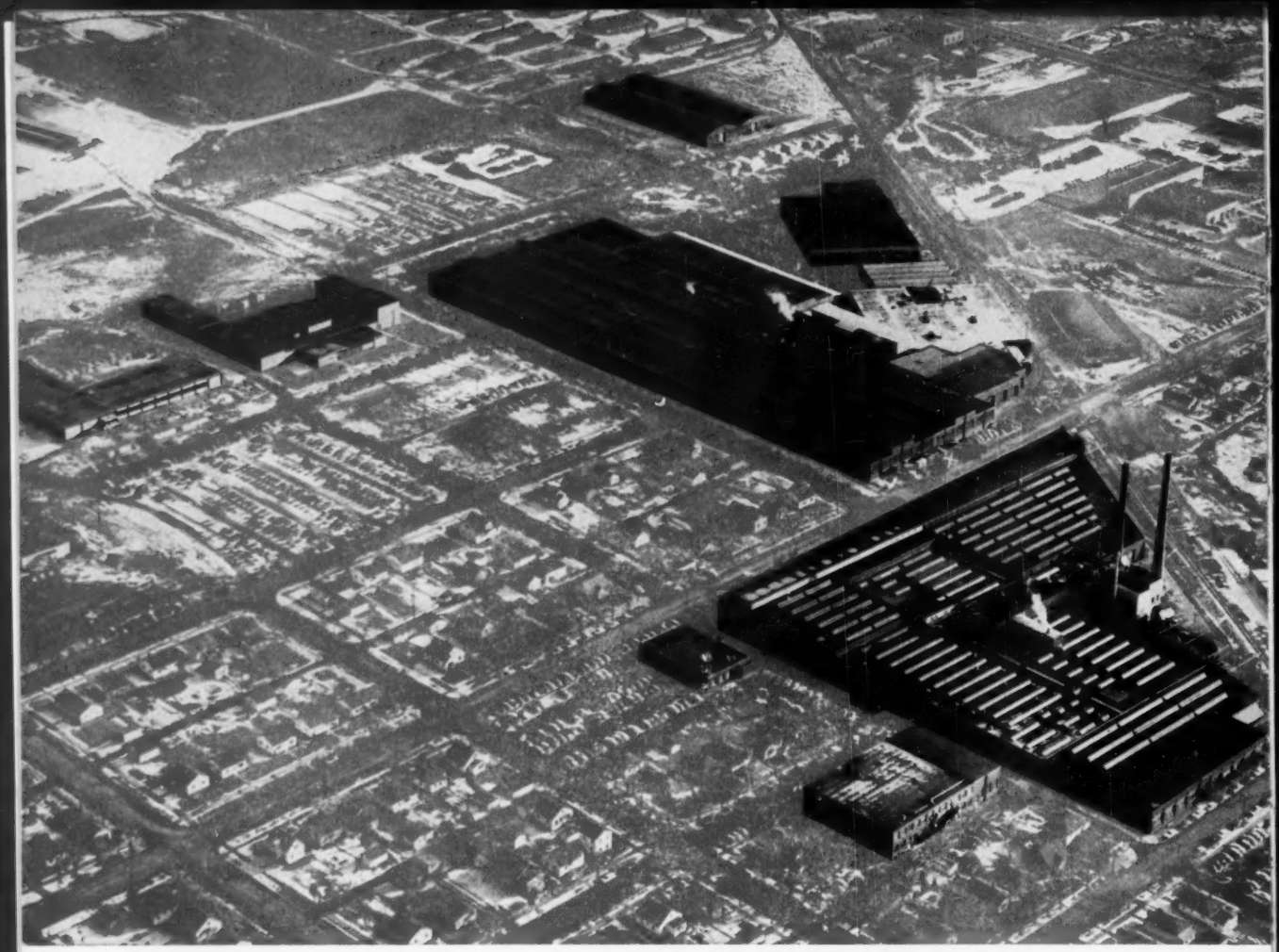
ALCO

ALCO PRODUCTS, INC.

NEW YORK

Sales Offices in Principal Cities

Locomotives • Diesel Engines • Nuclear Reactors • Heat Exchangers • Springs • Steel Pipe • Forgings • Weldments • Oil-Field Equipment



Trane saves $27,000 a year burning coal the modern way

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

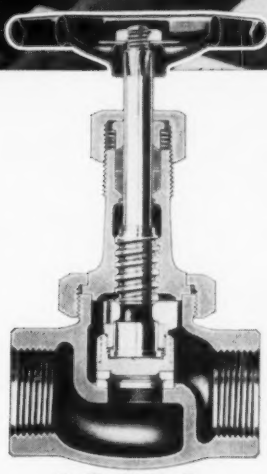
As part of its current $12 million expansion program at all locations, The Trane Company, La Crosse, Wis., a major air-conditioning and heating equipment manufacturer, has recently modernized its power plant. Steam generating facilities were changed over entirely to a coal-fired operation and a 70,000 lb./hr. boiler was added. Coal and ash handling is automatic.

Trane has found that burning coal the modern way pays off in several ways. Overall cost of steam generation is cheaper. Fuel supply is readily available and dependable. And fuel cost savings amount to 25% over the next most economical fuel, totaling about $27,000 a year for the La Crosse plant alone.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE
Southern Building • Washington 5, D. C.

IT'S TIME TO CUT *Maintenance* COSTS



LQ600

Backed by cost-cutting Distributor service . . . you can't beat the exclusive LQ600 for cost reduction. Its patented Brinalloy® seats and discs outwear even 500-Brinell or 1000-Brinell case-hardened stainless.

At no time in history have industrial valve maintenance costs been so high. Labor costs are skyrocketing. Add in your maintenance department overhead and the production time lost because of valve breakdowns, and your total maintenance cost figure is pretty close to the danger mark. The price of an ordinary valve is actually dwarfed by the cost of keeping it in operation. That's why it always pays to install *the best valves you can buy.* For nearly a hundred years, they've been made by The Lunkenheimer Company, Cincinnati 14, Ohio.

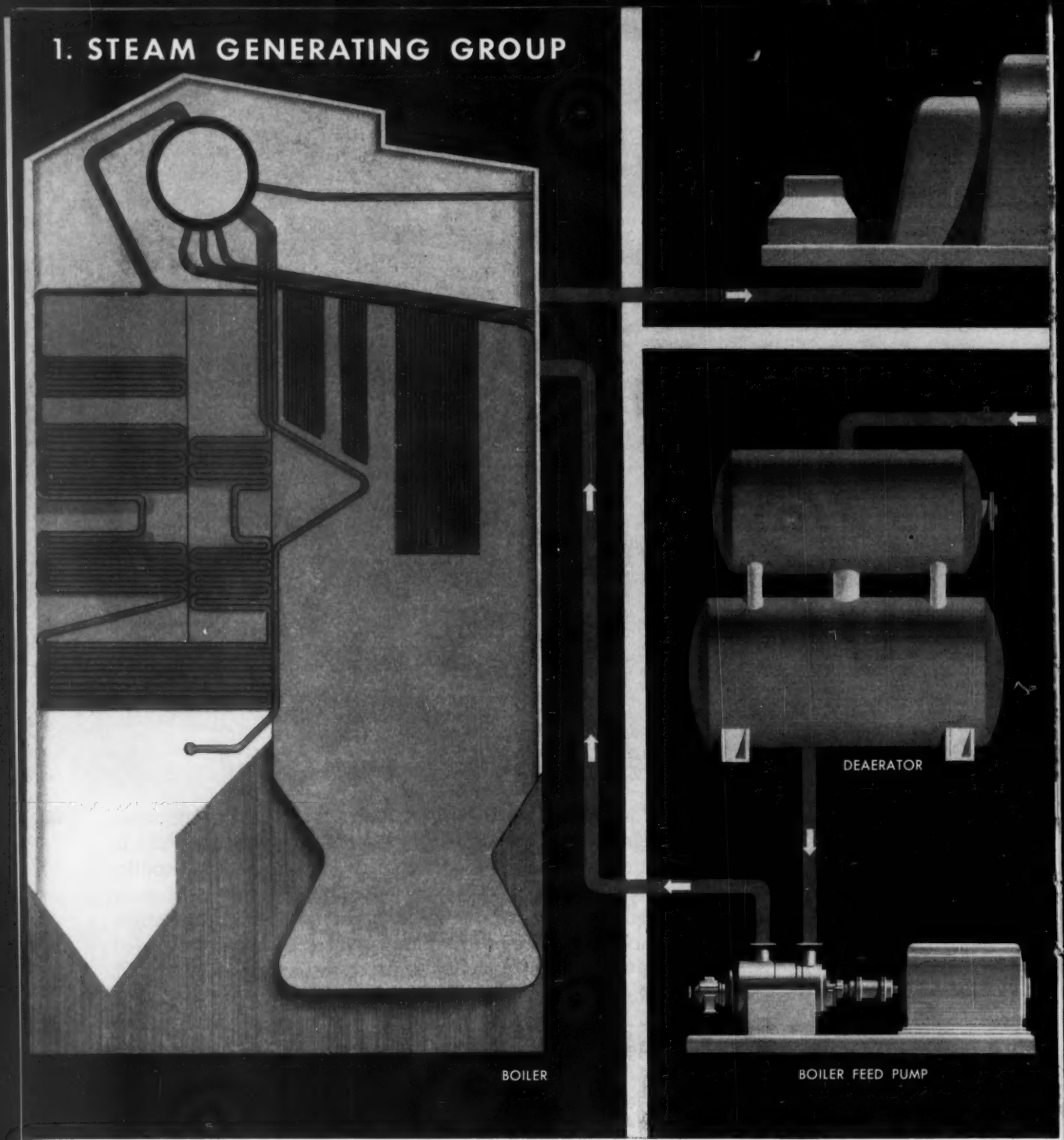
The cost of a LUNKENHEIMER VALVE
Gets smaller . . . and smaller . . . and smaller
with each passing year of dependable service.

BRONZE • IRON • STEEL • PVC ®

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

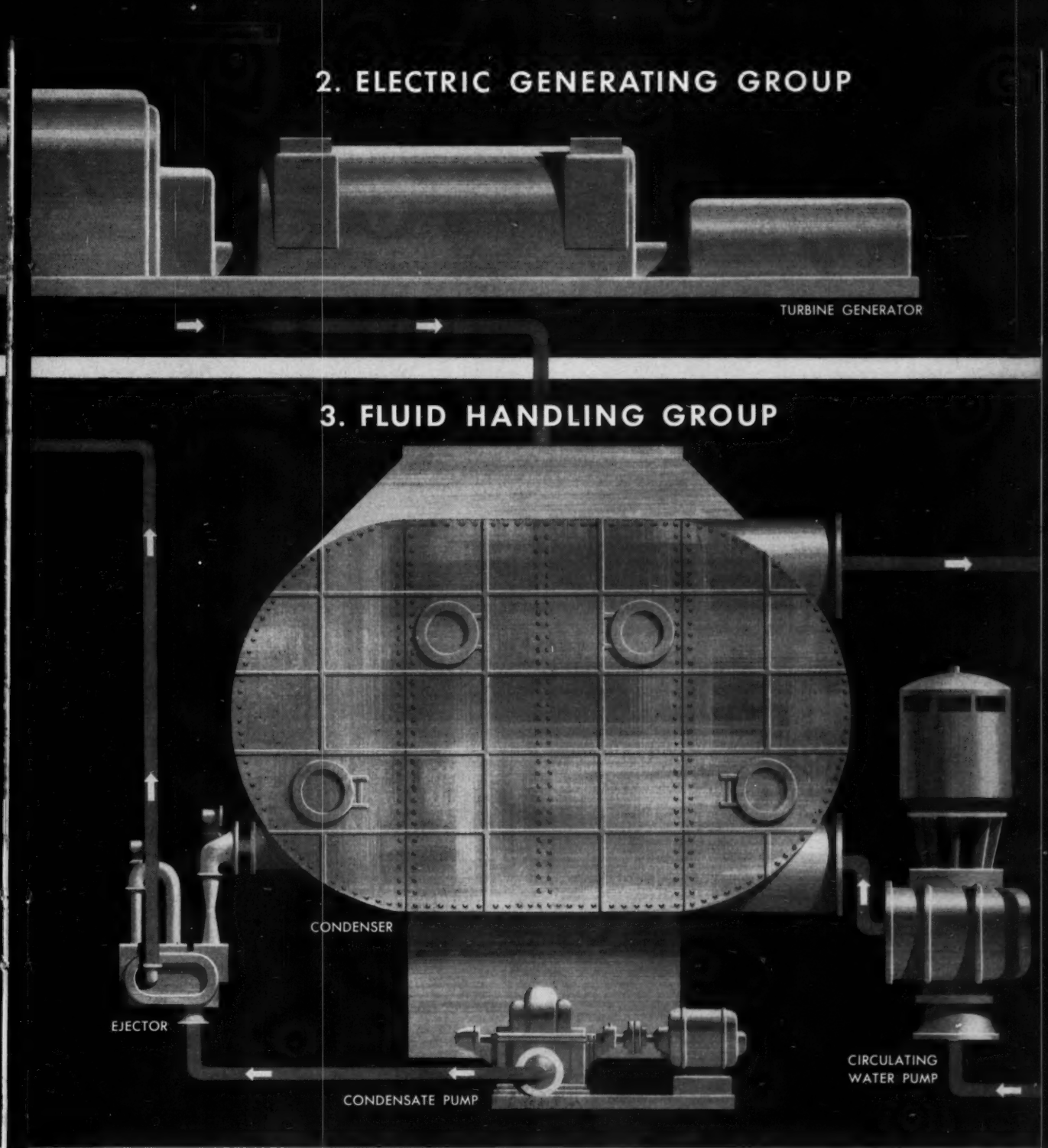
L-557-10



Look at all three

A new steam station design approach is bringing higher efficiencies, lower costs, and greater reliability. In this approach, only three basic functions are considered: (1) Steam Generating, (2) Electric Generating. (3) Fluid Handling. Station requirements are first analyzed in terms of the over-all job performed by each of these groups rather than by each individual piece of equipment.

Many of the benefits of this approach occur in the Fluid Handling Group. Here coordination and integration of the wide variety of equipment used can often effect substantial improvement in over-all operation. As steam temperatures and pressures go up, there are increased demands on the fluid handling function. Plant reliability often depends on the effect of one component of the fluid handling group on another during operational transients, either planned or of emergency nature. The solution is coordinated equipment



for power!

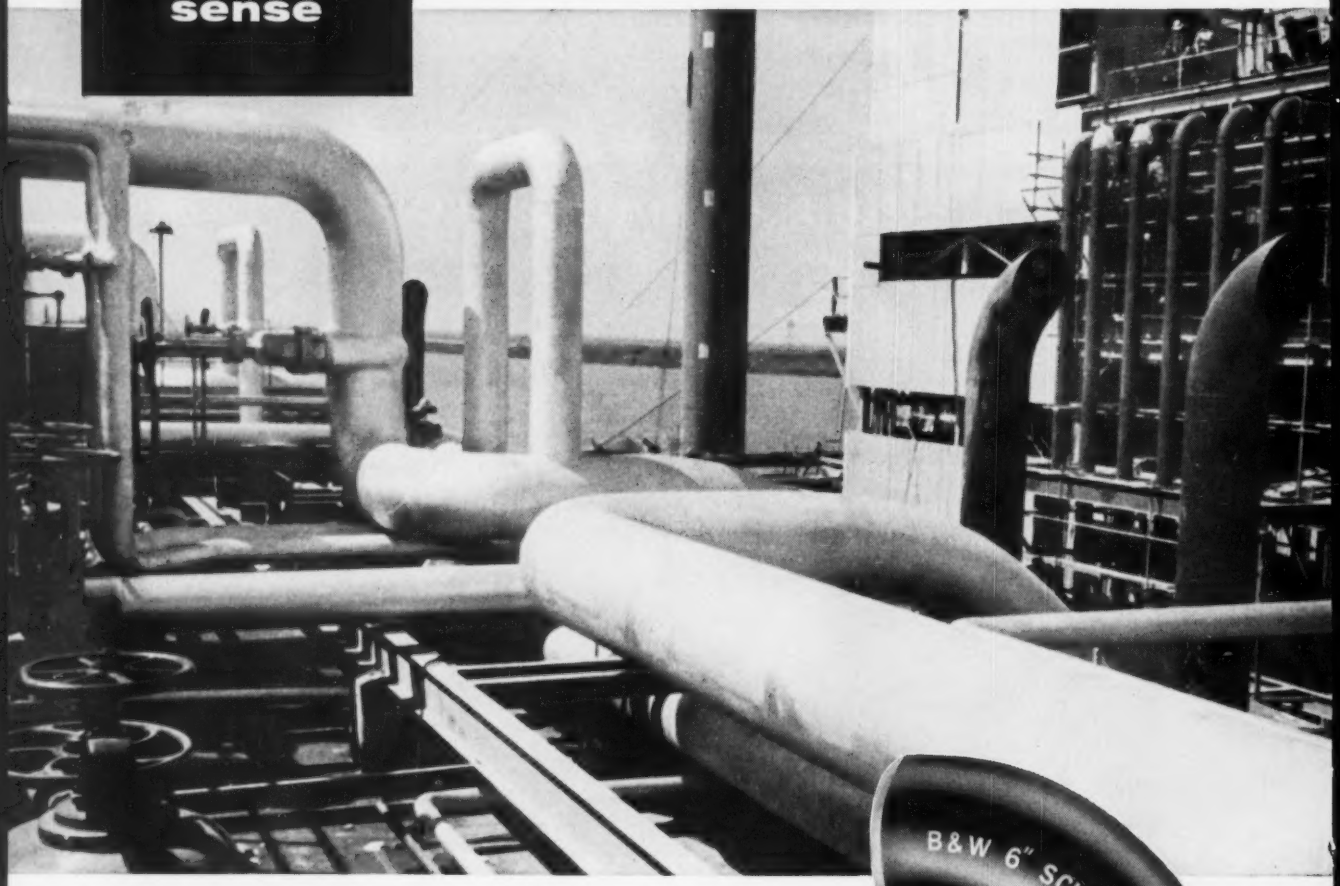
selection, engineering and design. And Worthington's "system" know-how and experience with modern complex plant cycles can help solve your fluid handling problems.

System-wise experience As the manufacturer of all major components of the Fluid Handling Group, Worthington has a reservoir of experience and knowledge that can be of benefit to you. To put this "system-wise" experience to work for you, get in touch with your nearest district office. Or write to section C-71, Worthington Corporation, Harrison, New Jersey.

WORTHINGTON

result of an engineer's good common sense

insulation is easier and faster to apply when seamless welding fittings are used



THANKS to the engineer who specified B&W Seamless Welding Fittings, no humps or bumps had to be insulated here. Welding fittings became an actual part of this smooth, streamlined piping. And with a sound weld, welded connections are leakproof, pipelines are permanent. Insulation never has to be restored because of leaky joints. Therefore, maintenance is practically non-existent.

Seamless Welding Fittings combine strength with lightness-in-weight and allow closer nesting. B&W's dimensional accuracy such as full radius, true circularity and smooth walls of uniform thickness permits uninterrupted flow even under highest temperatures and pressures.

Be sure — and specify B&W Seamless Welding Fittings and Forged Steel Flanges. They're available in a complete range of sizes and types in carbon steel and the B&W CROLOYS.

THE *NATURAL* SOURCE FOR ALLOY FITTINGS

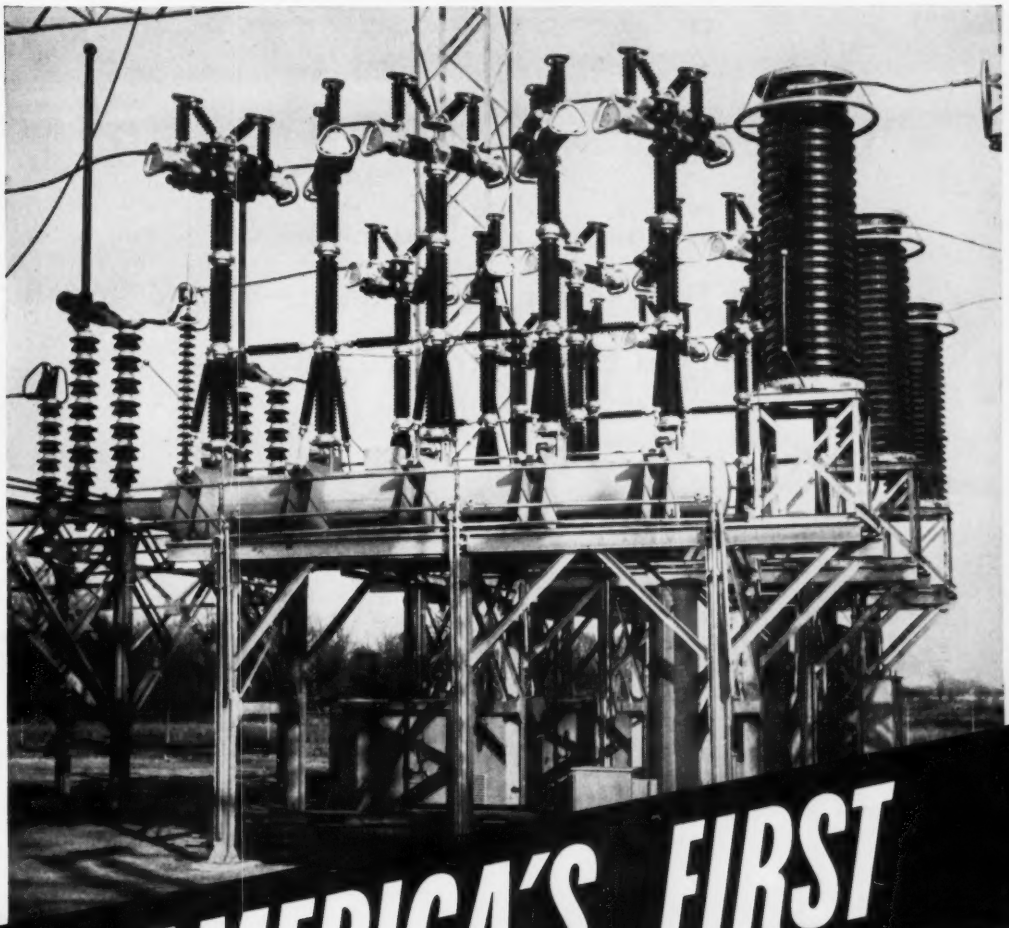
B&W

TUBULAR PRODUCTS DIVISION

FA-7906-FE-2

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION • FITTINGS DEPARTMENT
3839 WEST BURNHAM STREET • MILWAUKEE 46, WISCONSIN

Seamless welding fittings and forged steel flanges, seamless and welded tubular products — in carbon, alloy and stainless steels.



AMERICA'S FIRST 345 kv AIRBLAST BREAKER

BROWN BOVERI

THE largest Airblast Breaker ever installed in the United States was designed and built by the world's pioneers of Airblast Breakers, Brown Boveri. This 345 kv, 3-cycle breaker, with an interrupting capacity of 25,000,000 KVA, is in service at the East Lima Substation of the Ohio Power Company and is one of two such units in the American Gas and Electric System.

Contact Brown Boveri, the leaders in the field, if you want the BEST in BREAKERS!

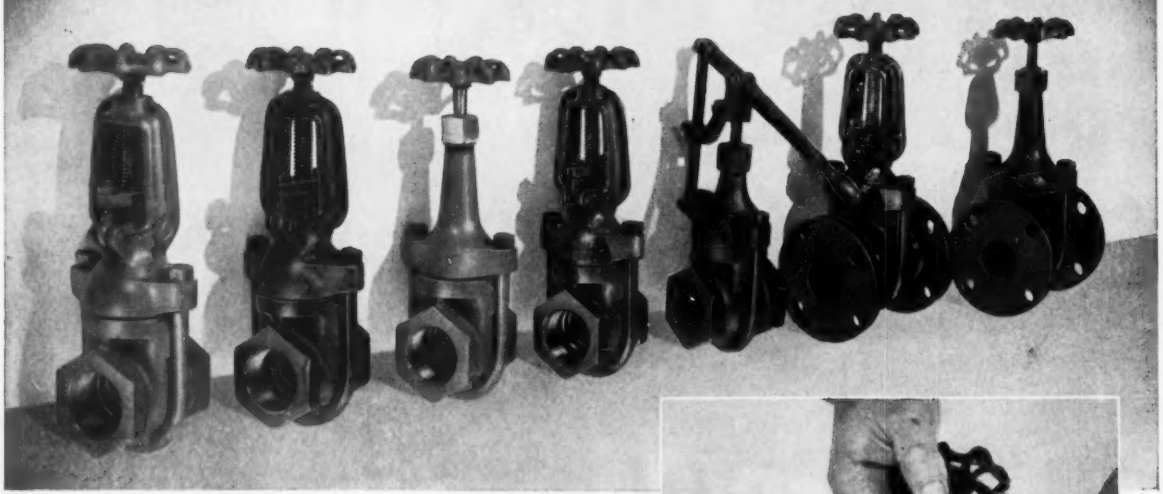
BROWN BOVERI CORPORATION

19 RECTOR STREET • NEW YORK 6, N. Y.

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Butte, Mont. • Chicago, Ill. • Cleveland, O. Denver, Colo. • Detroit, Mich. • Hamilton, O. • High Point, N. C. • Houston, Tex. • Jacksonville, Fla. • Kansas City, Mo. Knoxville, Tenn. • Lewiston, Me. • Miami, Fla. • Minneapolis, Minn. • New Orleans, La. • New York, N. Y. • Pasadena, Cal. Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • Seattle, Wash. • Syracuse, N. Y. • Tucson, Ariz.

Eleven lines of WALWORTH Saddle Type Wedge Gate Valves

Bronze-Mounted — All-Iron — Ni-Resist
Outside Screw and Yoke — Non-Rising Stem — Quick Opening
Flanged Ends — Screwed Ends



Walworth saddle-type wedge gate valves are manufactured in eleven different combinations of designs and materials, seven of which are illustrated above.

Saddle type wedge gate valves are easy to take apart and are particularly suitable for lines requiring frequent cleaning. Walworth Saddle-Type Wedge Gate Valves are available in a variety of designs including OS & Y; Inside Screw Rising Stem, and Sliding Stem Quick Opening types—in Bronze-Mounted, All-Iron, and Ni-Resist. All types are designed to permit repacking under pressure in either the open or closed position.

FOR COMPLETE INFORMATION, See your local Walworth Distributor or write on business stationery for illustrated circular.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION GROVE VALVE & REGULATOR CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. MH M & H VALVE & FITTINGS CO. WALWORTH COMPANY OF CANADA, LTD.

Another Example of Efficient Power at Lower Cost

For the Sixth* consecutive year... Cooper-Bessemer Power helps win R.E.A. "top-rated" award.

* This year an award for each of two divisions . . . and both plaques go to R.E.A. plants powered by Cooper-Bessemer engines.

Named Division B winner was the Green Forest station of M & A Electric Power Cooperative, Poplar Bluff, Missouri. Here, four identical 16-cylinder Cooper-Bessemer engines, each rated 3300 hp at 327 rpm, are in continuous, low cost operation.

At the Caro plant of the Thumb Electric Cooperative, Ubly, Michigan, three efficient Cooper-Bessemer engines helped earn the top award in Division A.

Learn for yourself how Cooper-Bessemer meets power requirements in the 200 to 5450 hp range at the lowest possible cost. Contact the nearest office.

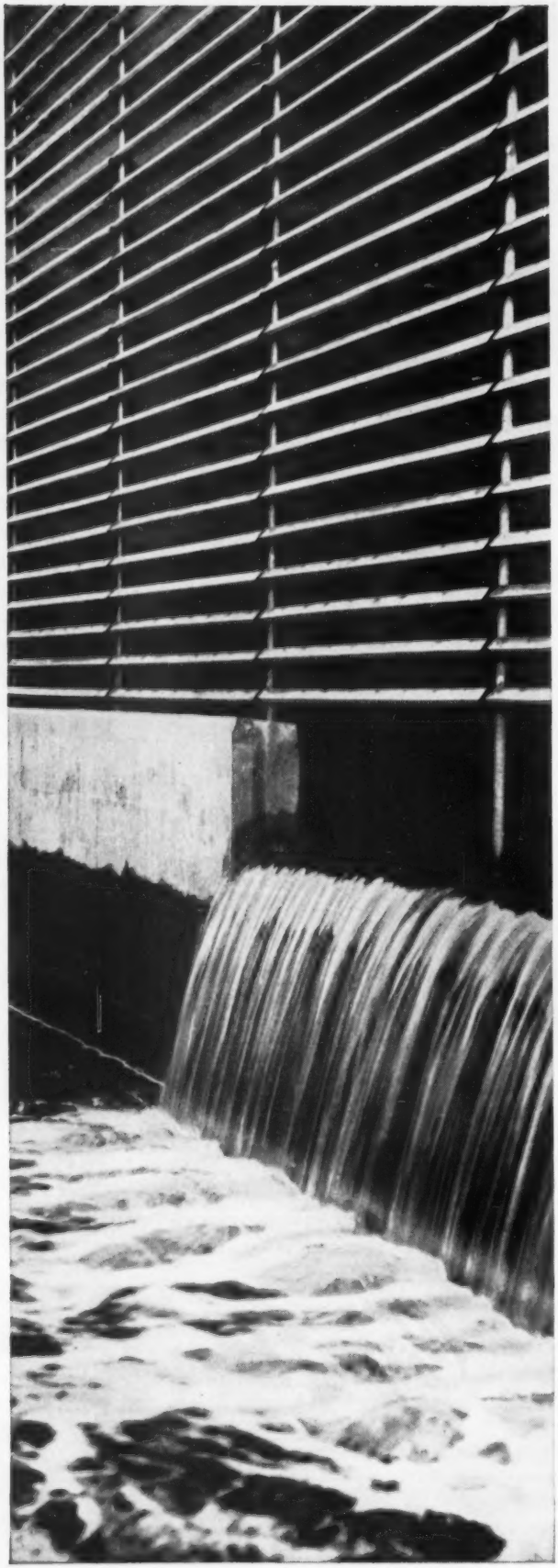
BRANCH OFFICES: Grove City • New York • Chicago • Washington • San Francisco • Los Angeles • Houston • Dallas • Odessa • Pampa • Greggton • Seattle • Tulsa • St. Louis • Kansas City • Minneapolis • New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Limited . . . Edmonton • Calgary • Halifax. Cooper-Bessemer International Corporation . . . New York • Chacao • Havana • Mexico City

Cooper/Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN



Wanted! 215,000,000,000 gallons of water per day!

Your process cooling towers may be doing a fulltime job now, but soon you'll have to work them overtime. By 1975, report authorities, industry *alone* will require 215,000,000,000 gallons of water per day!

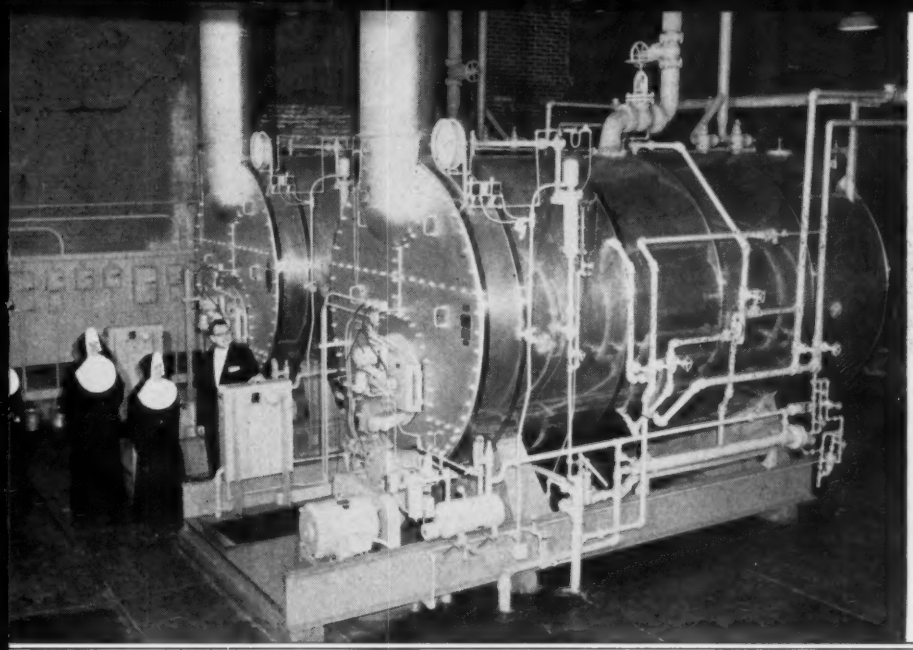
To stand up to such intensive usage, towers should have the protection that only continuous L&N pH control automatically provides. L&N engineers treat each tower as an individual pH problem. Its control system is engineered on the basis of L&N's pH Controllability Analysis. This appraisal of the tower's "controllability factors" (flows, retentions, concentrations, etc.) tells us whether pH is actually controllable under existing tower conditions. If the answer is negative, the analysis highlights what must be done to *make* pH controllable.

The benefits of this unique L&N approach are significant. They include, in the words of an operator of two 200,000-gallon towers, ". . . conserving large amounts of make-up water, wood protection, prevention of carbonate scale, and more effective slime control." His report adds that "automatic pH control at both plants has been effective and satisfactory."

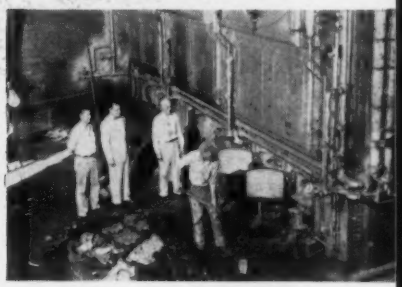
Write for Process Data Sheet 700(1), "L&N pH Control of Cooling Tower Water." You'll also receive our Controllability Analysis Questionnaire to complete and return, without obligation, for answers to your cooling tower pH problems. The address, Leeds & Northrup Co., 4910 Stenton Ave., Phila. 44, Pa.

LEEDS Instruments NORTHRUP Automatic Controls • Furnaces

Photo courtesy J. F. Pritchard Co.



NEW BOILERS combine efficiency and handsome appearance. Edward S. Green, Edgemont (Pa.), contractor, was responsible for this superior installation. Pictured left to right are: Sister M. Cor Immaculatum, Immaculata College Treasurer, Sister Jean Marie, Community Treasurer, Reverend Mother Maria Alma, Superior General and Salvatore S. Guzzardi, Consulting Engineer.



OLD BOILER was a coal-fired HRT model — typical of many replaced by modern Cleaver-Brooks oil, gas or combination oil/gas fired boilers.

Consulting engineer* tells how Immaculata College boiler modernization saves estimated $12,000 each year

Salvatore S. Guzzardi CONSULTING ENGINEER

2928 LEWIS TOWER · PHILADELPHIA 2, PA · KINGSLEY 6-2777

December 20, 1956

Mr. John C. Cleaver, President
Cleaver-Brooks Company

Dear Mr. Cleaver:

Recently our office was retained to make an impartial, exhaustive engineering study of the 40-year old boiler plant and steam system at Immaculata College, Immaculata, Pa., which is staffed by the Catholic order, Sisters of the Immaculate Heart of Mary.

As a result of our recommendations, two fully automatic, oil-fired, 350 bhp Cleaver-Brooks package steam boilers, (12,000 lbs/hr steam each), replaced three hand-fired coal boilers and steam-driven auxiliaries. The new boilers are operating at approximately 80% boiler efficiency year-round.

Conversion of coal firing to automatic #6 oil firing and increased boiler efficiency has reduced the fuel cost approximately 50% -- amounting to a saving of $12,000 each year.

The Cleaver-Brooks boilers burn #6 oil and operate automatically at 80 pounds steam pressure 'round the clock -- without the presence of operators in the boiler room. Eliminating boiler plant labor saves the College $7,500 each year.

The cost of the boiler plant modernization will be paid for out of fuel and labor savings in approximately 2-1/2 years.

Commendation for this outstanding performance of the Immaculata boiler plant is due to your well-engineered boiler design and to the cooperation of your skilled servicemen. The results achieved were so impressive that the Sisters subsequently modernized their Villa Maria Convent, Westchester, Pa., with two 100-bhp Cleaver-Brooks boilers.

Sincerely yours,

Salvatore S Guzzardi

***Salvatore S. Guzzardi** — Award-winning head of an organization of experienced professional engineers specializing in modernizing power service facilities. Clients include: Pennsylvania University, Baldwin-Lima-Hamilton Corp., H. Daroff & Sons, Sun Shipbuilding & Dry Dock Co. and City of Philadelphia.

Surveys show 32% of boilers now in service are 30 years old; 56% are over 20 years old

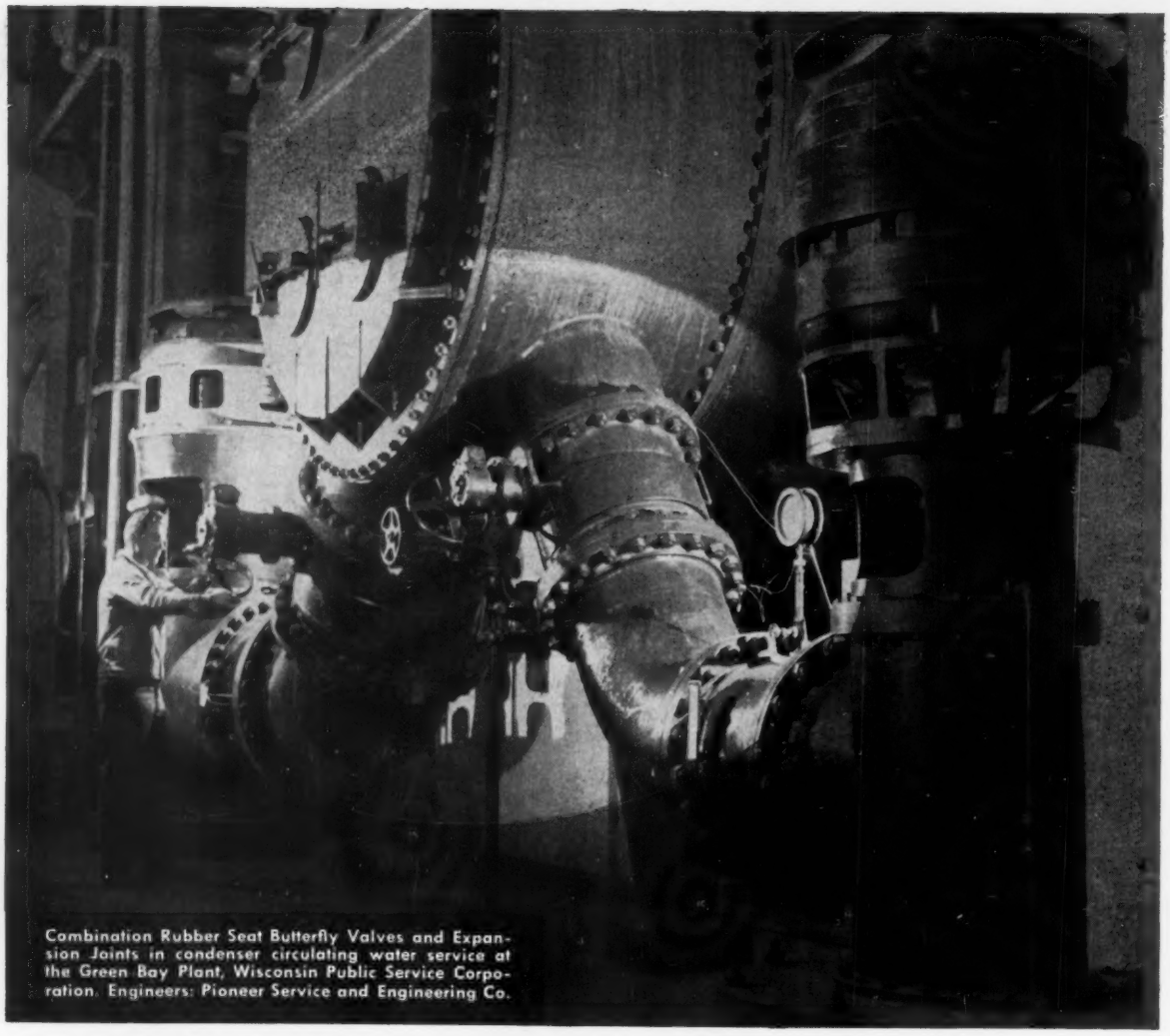
If your boiler fits this description, we recommend an immediate survey. "In 90% of the plants surveyed," summarizes Mr. Guzzardi, "we have found it possible to save thousands of dollars and to pay for the recommended improvements out of annual savings within one to three years."

Again and again the proved economy of Cleaver-Brooks four-pass, forced-draft boiler design results in savings reports as impressive as this. Contact your nearest Cleaver-Brooks representative for more facts on the complete line of steam and hot water boilers — 19 sizes, 130 models, 15 to 600 hp — for heating or processing. Or write Cleaver-Brooks Company, Dept. F, 301 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CLEBRO — Milwaukee — all codes

Cleaver-Brooks Boilers Are Manufactured Under License By Tomlinson Steel, Ltd. 214 Wellington St. Perth Western Australia

Cleaver Brooks

ORIGINATORS OF SELF-CONTAINED BOILERS



Combination Rubber Seat Butterfly Valves and Expansion Joints in condenser circulating water service at the Green Bay Plant, Wisconsin Public Service Corporation. Engineers: Pioneer Service and Engineering Co.

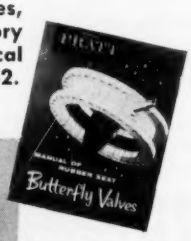
GREEN BAY...Combines Butterfly Valves with expansion joints for new economy

Drop-tight shutoff, plus provision for pipeline expansion and ease of assembly are provided here in one compact Pratt unit. By combining the Butterfly Valve with the expansion joint, space requirements are minimized and maintenance (and initial cost) of one set of flanges and bolts is eliminated. This is a typical Henry Pratt engineering job—the mechanisms are the simplest available . . . for economy and minimum maintenance, and they are carefully designed and built for peak efficiency and operating ease.

Henry Pratt pioneered the use of Rubber Seat Butterfly Valves in power plants. Combined with permanently drop-tight shutoff, the inherent simplicity and compactness of this valve permitted a new concept of large-diameter valving by power plant engineers.

Pratt Rubber Seat Butterfly Valves grew with the Power Industry for thirty years, and today are being installed in modern, nuclear power plants. For valve design—with **imagination**—see Henry Pratt.

NEW! Latest, most accurate pressure drop and flow data, conversion tables, discussion of butterfly valve theory and application plus other technical information . . . Write for Manual B-2.



HENRY PRATT

RUBBER SEAT Butterfly Valves

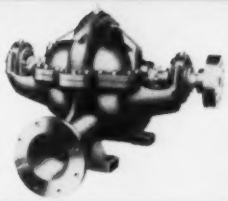
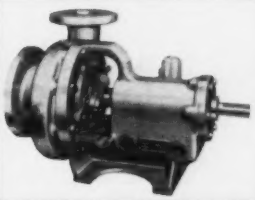
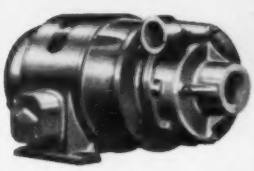
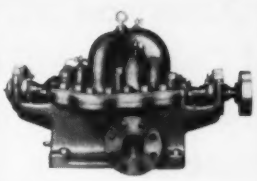
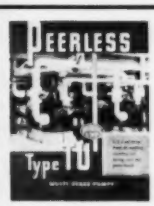
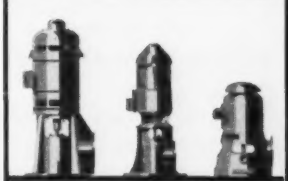
Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

5 Peerless Pump Designs

that squarely meet every

LIQUID HANDLING REQUIREMENT

PEERLESS PUMPS

THESE ARE THE *Pumps*	ASK FOR *FREE* ENGINEERING BULLETINS
TYPE A AND TYPE AS GENERAL PURPOSE PUMPS Use these pumps in the widest range of water handling services. Single stage, horizontal split case design. Mechanical shaft seal construction available in sizes up to 4" (Type AS). Heads: up to 300 ft.; capacities up to 70,000 gpm.		*Ask* FOR BULLETIN B-1300 & B-1350
TYPE DL AND DM CHEMICAL PROCESS PUMPS Combine quality with economy through a practical idea of component interchangeability between pump types. Oil and grease lubricated bearing housings. Packing gland or shaft seal designs. Air or water cooled back plates. Heads to 430 feet; capacities to 800 gpm. Pressures to 400 psig.		*Ask* FOR BULLETIN B-1608
TYPE PE AND TYPE PB END-SUCTION PUMPS America's broadest line of economical, general purpose pumps. Horsepower range from ¼ to 150. Head range to 260 ft. Capacities up to 5500 gpm. Easy to buy, apply, install and maintain. Tens of thousands in use.		*Ask* FOR BULLETIN B-2300
TYPE TU AND TYPE TUT MULTI-STAGE PUMPS 2,3,4 and 5-stage designs for supplying, circulating and boosting water and other liquids in moderate capacities against medium and high heads. Durable and dependable in operation. Heads up to 1660 feet; capacities up to 3000 gpm.		 *Ask* FOR BULLETIN B-1400
VERTICAL INDUSTRIAL SERVICE PUMPS Heavy duty, extra heavy duty and process service types for application to cooling tower service, tank pumping, etc. One of the proudest lines manufactured. Save on piping, always primed, require minimum floor space. Heads to 1000 feet; capacities: 30 to 40,000 gpm. HP range: up to 2500 h.p.		*Ask* FOR BULLETIN B-505

MAIL COUPON FOR ILLUSTRATED BULLETINS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORP
Factories: Los Angeles, Calif., and Indianapolis, Ind.
Offices: New York; Atlanta; Chicago; St. Louis; San Francisco; Phoenix; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque, New Mexico.
Distributors in Principal Cities; Consult your Telephone Directory

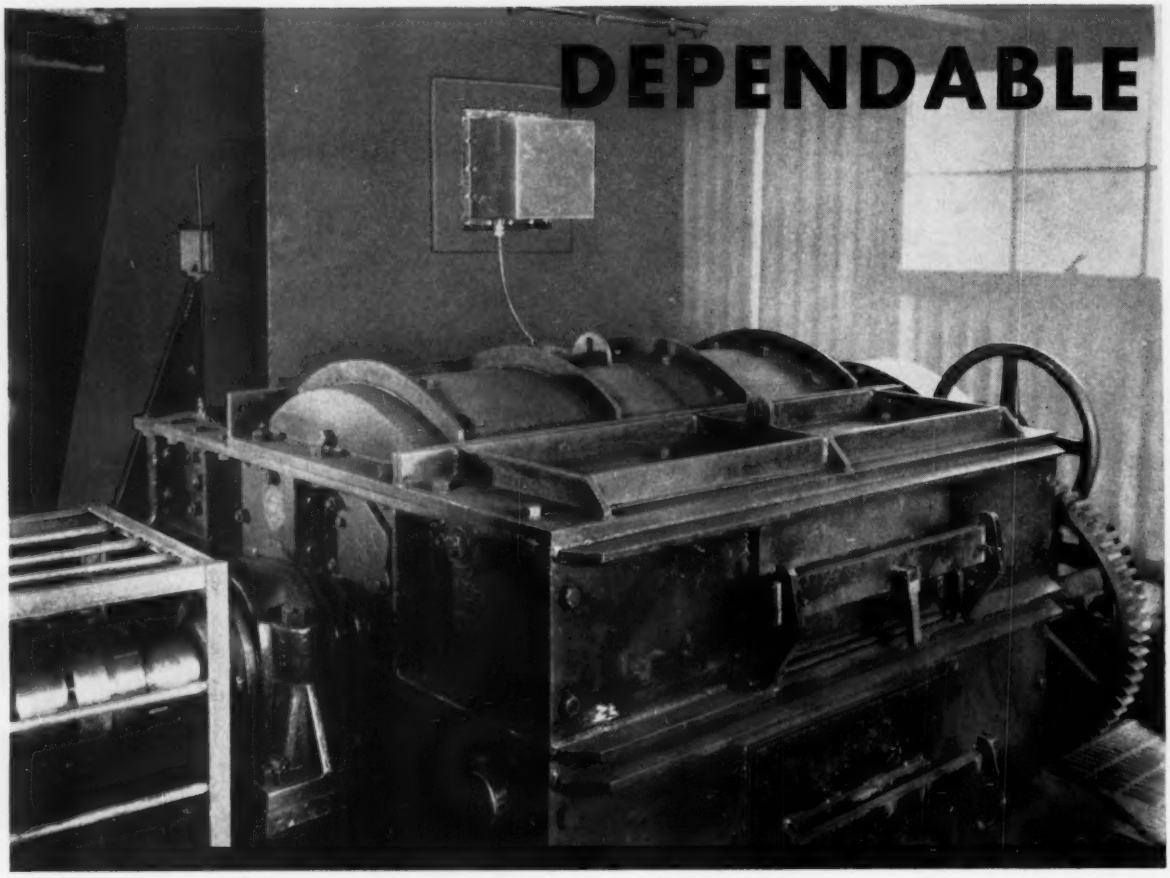
PEERLESS PUMPS

fmc FOOD MACHINERY AND CHEMICAL CORP.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 W. Ave. 26, Los Angeles 31, California
Please send Bulletins checked below

- ☐ Type A Bulletin B-1300
- ☐ Type AS Bulletin B-1350
- ☐ Type DL-DM Bulletin B-1608
- ☐ Type PE-PB Bulletin B-2300
- ☐ Type TU Bulletin B-1400
- ☐ Vertical Types Bulletin B-505

NAME _____
ADDRESS _____
CITY _____ STATE _____
POW



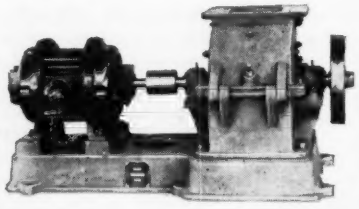
Without a repair or replacement part, this American AC Rolling Ring Coal Crusher reduced over 550,000 tons of minus 8" lignite to a 3/4" product

. . . proof of what American Coal Crushers will do for you.

Write for American AC bulletin.

FOR DEPENDABLE SAMPLE CRUSHING

Model 15 x 9 American Sample Crusher with capacity of 2000 lbs. per hour. Write for Bulletin 157.



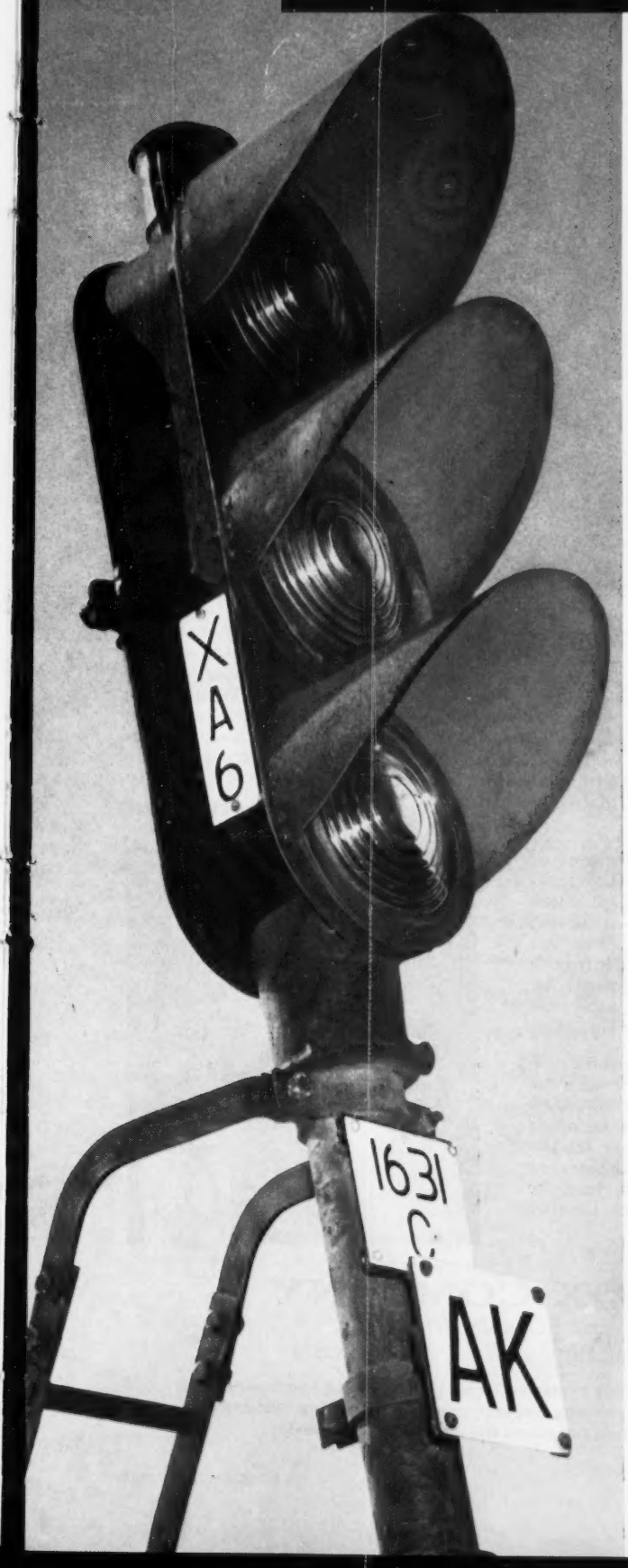
"When you figure Costs — the best results come from American Rolling Ring Crushers".

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

where **POWER** is **VITAL**



ASCO AUTOMATIC TRANSFER SWITCHES help insure the safety of New York's subway millions

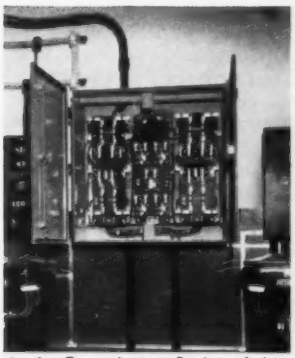
More than 4½ million commuters use the New York City subway system daily during the working week. Their safety is a major concern of the New York City Transit Authority. That is why the NYCTA insures against power failure with stand-by power. When normal power fails, ASCO Automatic Transfer Switches automatically transfer the load to the emergency source.

The Transit System's new and modern station at Grant Avenue in Brooklyn, N. Y., is typical. There ASCO switches assure continuous adequate-voltage power for a wide range of equipment: train signals, safety devices, station lighting, ventilation and drainage.

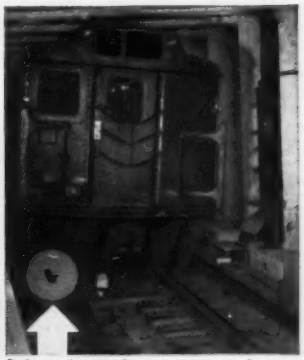
Dependable Control by ASCO

Wherever power and dependability are vital, ASCO switches provide these notable advantages: *continuous duty rating* in either normal or emergency position . . . *capacity* to withstand inrush currents 20 times full load rating . . . *rated* 750 volts A-C or D-C . . . *mechanical locking* to safeguard against vibration and electromagnetic effects . . . *single coil design* . . . *built-in time delay* so that equipment ignores harmless momentary outages . . . *full phase protection*, high thermal capacity, and many other design features and accessories. That is why safety-minded engineers specify ASCO – the one source for a full line of dependable automatic transfer switches. Write for Publication 596 on how to select an adequate automatic transfer switch. Or write in *on company letterhead* specifying Catalog 57-S1 covering complete line of ASCO automatic transfer switches.

Critical Subway equipment depends on continuity of adequate voltage power



At the Grant Avenue Station of the NYC subway system, this electrical distribution room features ASCO Transfer Switches which "throw in" emergency power for station and tunnel lighting and safety devices.

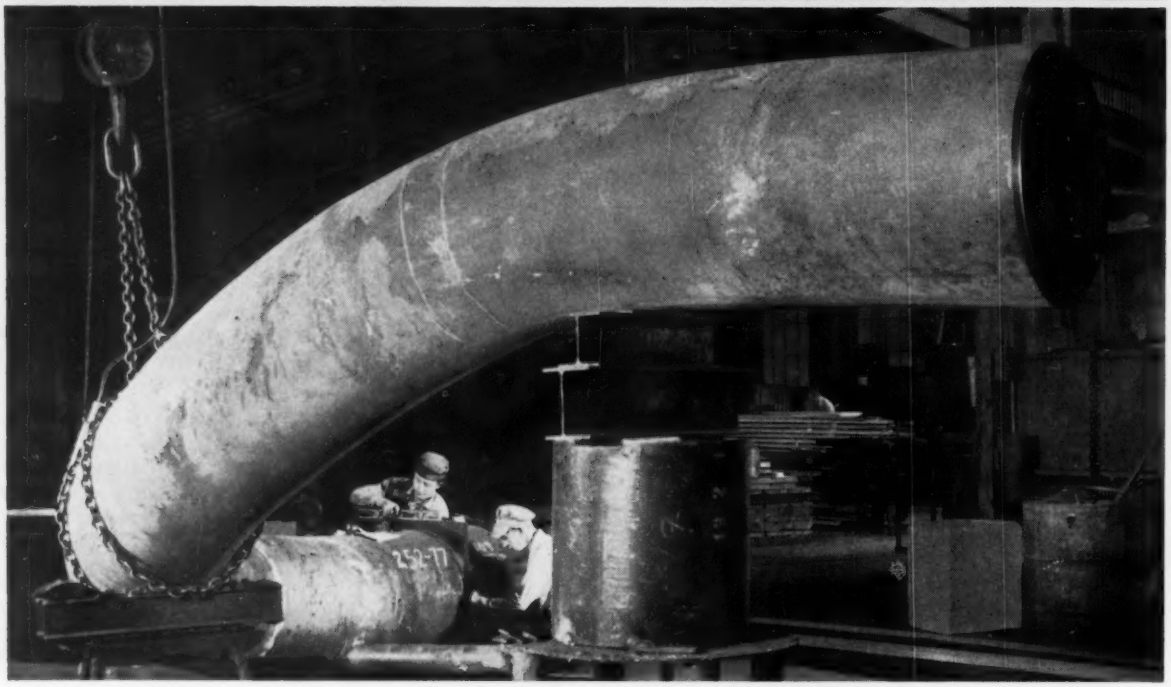


Safety trip which prevents train from passing through red lights relies on ASCO switch for emergency power.

Automatic Switch Co.
54-1 Hanover Road, Florham Park, N. J. FIreatler 7-4800

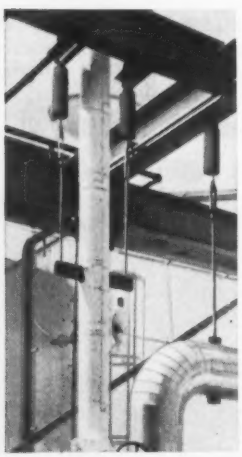
ASCO

BLAW-KNOX has what it takes—to provide these products and services



Large chrome moly pipe being readied for shipment to new generating station. Making a right angle bend followed by a 24 degree, 18 foot bend in this heavy 27½ inch chrome moly pipe required all the skill and modern facilities of the Blaw-Knox power piping shop. Before shipment, piping is heat-treated and ultrasonically tested with a radar-type device for detection of any defects.

A new Blaw-Knox "6 x 6" Flexibility Matrix Method of computing stresses in power piping systems is now available to consulting engineers, companies, and individuals responsible for the design of power piping systems. By the use of an electronic computer this method cuts calculating time from months to a day; assures full accuracy to six significant figures; and has no limitations on the complexity of the system. Write for further information about our new "6 x 6" Flexibility Matrix Method.



Two-way control over movement of piping is provided by Blaw-Knox functional spring hangers with the patented internal swivel action—shown in this modern outdoor generating station. Our experienced engineers are available to both design and make recommendations for your hanger requirements. To get full information, write for Catalog No. 54.

Each year serious fire strikes one out of every seven manufacturing firms in this country. Be safe. Let a Blaw-Knox fire-protection engineer study your needs —and explain how you can pay for the system on our lease or deferred payment plan. To get more information send for Bulletin No. 2426—"Fire Can Destroy Your Business."

BLAW-KNOX COMPANY

Power Piping and Sprinkler Division

829 Beaver Avenue • Pittsburgh 33, Pennsylvania

Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures . . . complete line of standard and custom-engineered pipe hangers, supports and vibration eliminators . . . complete line of automatic sprinkler systems for standard and special hazards

don't waste steam

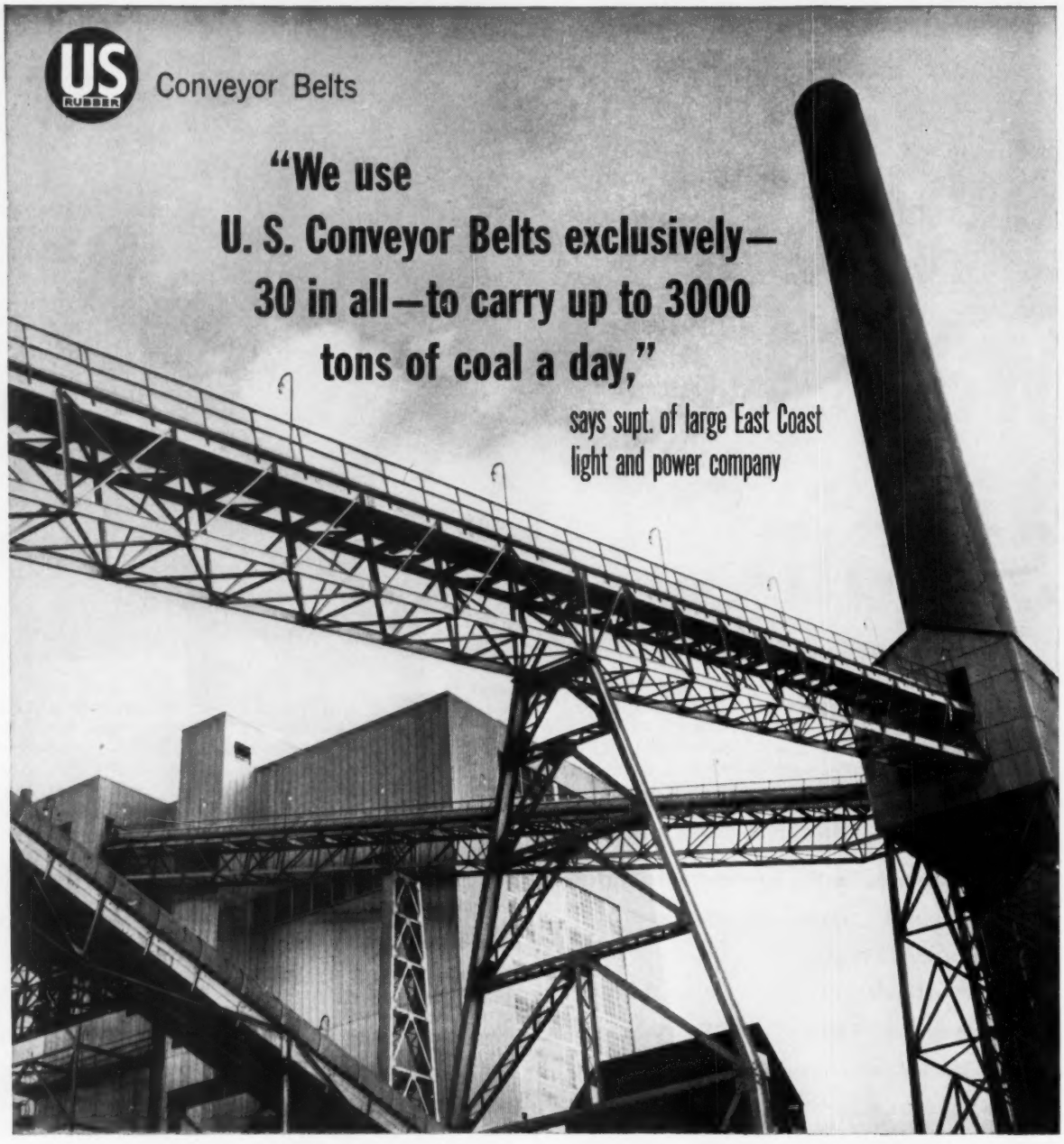
Nicholson steam traps have a powerful, intermittent valve action which closes the valve *completely*. Hardened stainless steel valve and seat are lapped and mated—there's no steam waste, no dribbling. And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous and low-cost operation of your steam-using equipment . . . no downtime from trap failure.

- **high air-venting capacity . . . for faster warmup of equipment.**
- **small and lightweight . . . easy to pipe and support.**
- **each unit steam-tested before shipment.**

So, to get a trap that avoids waste, saves money, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. *Sales and Engineering offices in 98 principal cities.*

Write for Bulletin 1055

NICHOLSON
of Wilkes-Barre


US RUBBER
Conveyor Belts
"We use
U. S. Conveyor Belts exclusively—
30 in all—to carry up to 3000
tons of coal a day,"
says supt. of large East Coast
light and power company

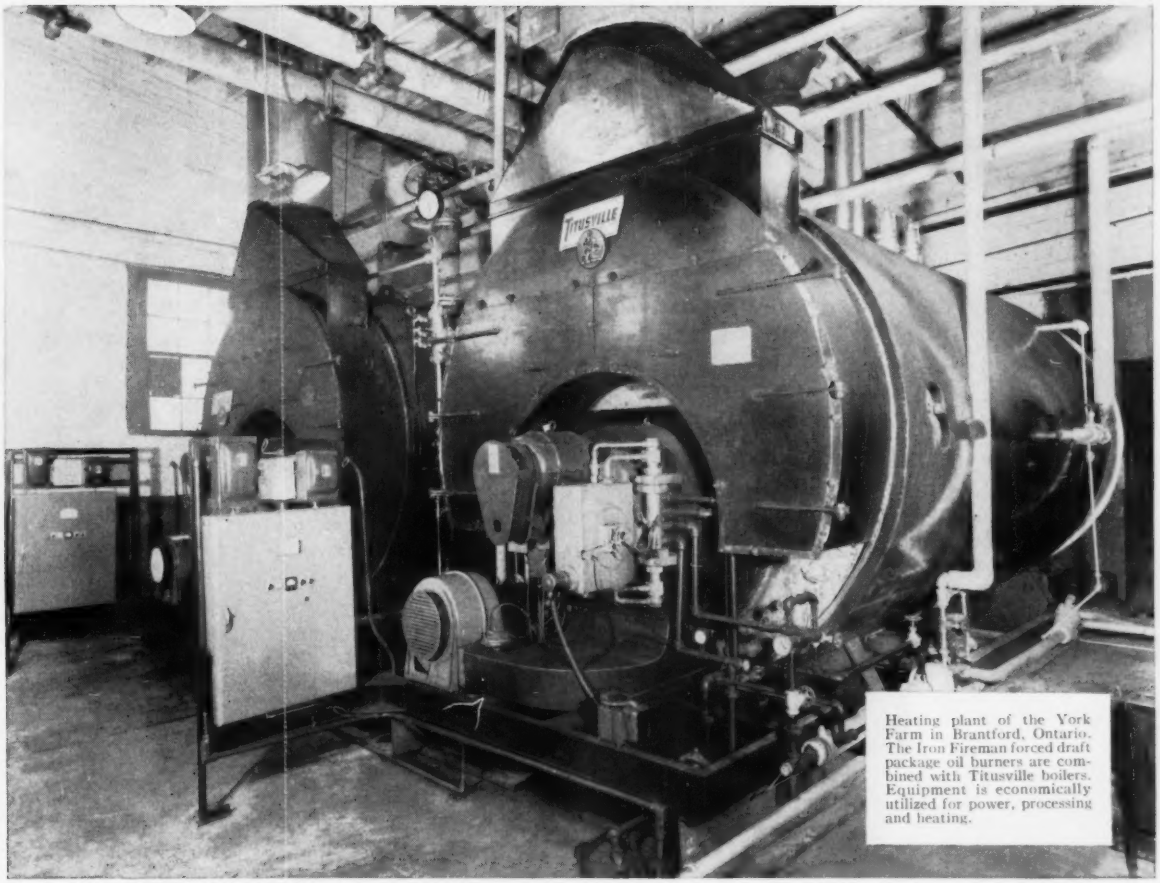
The giant generating plant of this large New England light and power company, furnishes enough electric power for a city of 165,000 people. Thirty "U.S." Conveyor belts carry the 3000 tons of fuel in a round-the-clock operation.

"Our needs are constantly expanding," says the super, "and we intend to use 'U.S.' belts exclusively. Belting is the best way to carry coal... and the best belting is U.S. Rubber. Maintenance is usually confined to inspection and lubrication. We expect many years of service from these belts."

That's the story everywhere. High-volume operators are using "U.S." Belting, and the result is always *lower costs.* Like so many other successful belting installations, the system in this light and power plant is the result of United States Rubber's "Three-Way Engineering"—in which "U.S." engineers work with the engineers of the conveyor builders and engineers of the power company to turn out the best belt conveyor system for the specific job.

U. S. Rubber Conveyor Belts and expert engineering assistance are available at any of the 28 "U.S." District Sales Offices, or write us at Rockefeller Center, New York 20, N.Y.

US RUBBER
Mechanical Goods Division
United States Rubber



Heating plant of the York Farm in Brantford, Ontario. The Iron Fireman forced draft package oil burners are combined with Titusville boilers. Equipment is economically utilized for power, processing and heating.

These Iron Fireman Package Firing Units Saved the Owner $10,478 in One Year

York Farms in Brantford, Ontario reports that in 1954 fuel costs were $35,650.00. In 1955, after installation of the Iron Fireman forced draft oil burners with matched boilers, the fuel cost was reduced to $25,171.45 . . . a saving of $10,478.55!

Iron Fireman firing system is engineered as a single complete unit. The Iron Fireman "package" burner is a complete combustion system including burner, control panel, forced draft air supply and fuel system, all of which are correctly balanced, integrated, wired and tested at the factory. With Iron Fireman there is no divided responsibility—no locally assembled job with separate estimates and contracts. Rather it means a factory engineered unit which assures dependable performance, high operating efficiency and low fuel cost.

Fits all types of boilers. Firing units can be applied to any type of boiler with great advantages in installation costs and operating efficiency. Installation requires little more than bolting the entire unit to the boiler front and making service connections for power and fuel.

For gas or oil, or gas-oil combination. Takes any type of high or low pressure gas, or any grade of oil from No. 2 to No. 6. Oil-gas models can be switched from one fuel to another at a moment's notice without loss of firing efficiency. For full information, please mail the coupon below.

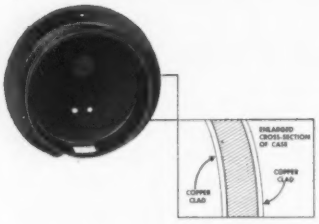
IRON FIREMAN.

AUTOMATIC FIRING EQUIPMENT
FOR OIL • GAS • COAL

IRON FIREMAN MANUFACTURING COMPANY
3332 West 106th Street, Cleveland 11, Ohio
In Canada: Write 80 Ward Street, Toronto, Ontario
Please send complete technical description and specifications.

Name_____
Company_____
Address_____
City_____ Zone____ State_____

You're looking at the biggest pressure gauge development since the "Recalibrator"



Another first for Marsh

Here is a case in keeping with the "Conoweld" tube. Another recent Marsh development, it is called the

New *Marshalloy* Case

It is a copper-clad wrought steel case of boiler plate thickness, four times as strong, and one-third lighter than conventional cast iron cases. Copper surface makes it as non-corrosive as a plastic or die-cast case. Handsome, corrosion-resistant, satin black enamel and Marsh safety blow-out plug are the finishing touches.

Here is one of those typically MARSH developments . . . the kind of pioneering step you have come to expect from the organization that originated the basic advances in pressure gauges culminating in the exclusive "Recalibrator." This latest Marsh development is known as the

NEW MARSH *"Conoweld"* TUBE

This time we have made the best part of the best Marsh gauge still better. We have gone into the part that actually does the work — the socket and tube — and have made it permanently leak-tight from inlet to tip of tube.

We have done this by fusing the tube into the socket and the tip to the tube so that the whole assembly is truly *one piece.* The photo of one of the sockets sawed in half shows the perfect fusion of the vital joint. Tests and photomicrographs prove the perfection of the fusion.

Developing the fusing process called for extensive research. The method as finally perfected — the "Conoweld" process — involves first fusing the tube to the socket and end-piece; then tempering the tube to required resiliency.

Yes, it is these dramatic departures from beaten paths that have achieved leadership for Marsh gauges and are ever increasing that leadership. Ask for latest information covering gauges for all services.

MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corporation* **Dept. F, Skokie, Ill.**

Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta

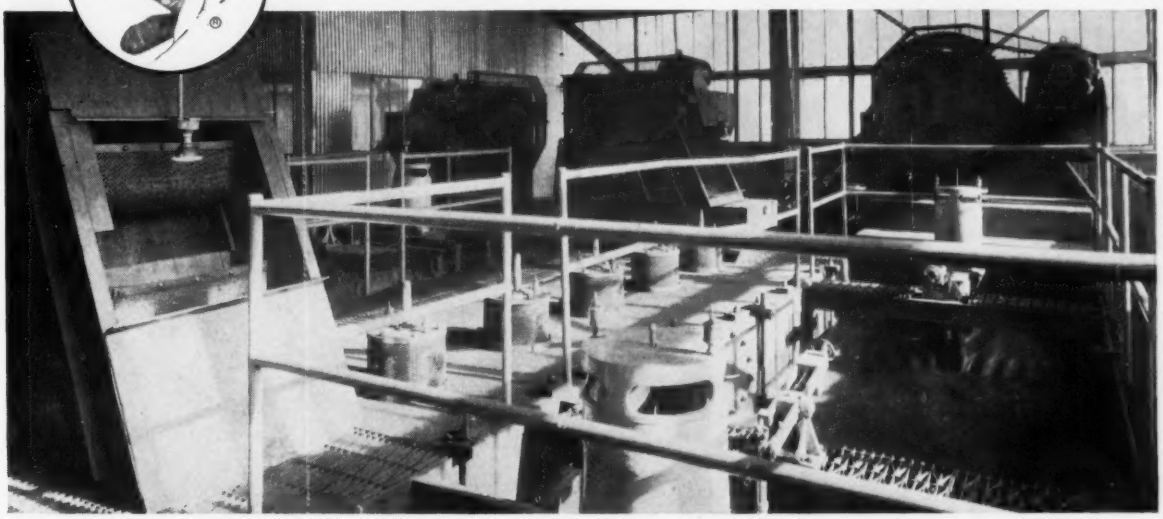
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

MARSH GAUGES

"THE STANDARD OF ACCURACY"

MANUFACTURERS OF THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES • HEATING SPECIALTIES

WHY CHESSIE'S RAILWAY IS FIRST IN COAL



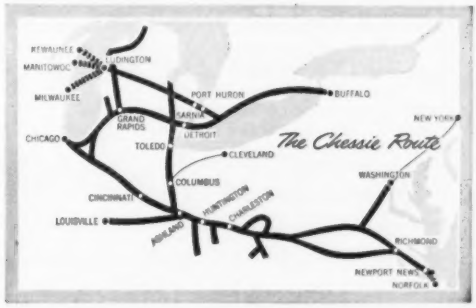
SUPERIOR COAL. The entire output of this mine is processed by automatic compound coal cleaning equipment. Producers on the Chesapeake and Ohio are prepared to supply you with highest quality coal of the type best suited to your needs and processed to your own specifications.

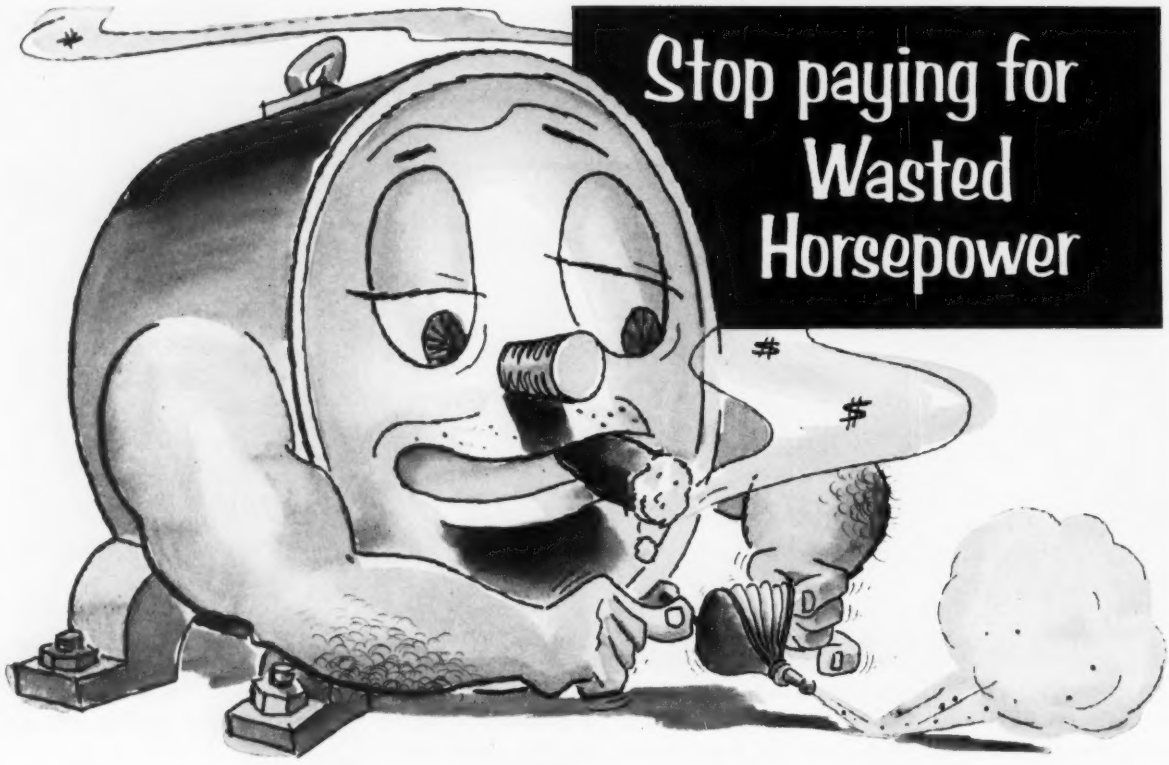
SUPERIOR SERVICE. To its present fleet of 63,780 coal cars—largest in the world—C & O is adding another 8,000. New high-speed yards, new locomotives and a new teletype car reporting system bring you faster, more dependable service.

For dependable deliveries of top quality coals, contact coal producers on the C & O. And for specific help in meeting your own fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Co., Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL





Stop paying for Wasted Horsepower

Just match your average load . . . let silicones carry the overloads

If you specify horsepower to equal "peak overloads," your motors work at full rated capacity only part of the time — you're paying for unused horsepower. Today, silicone insulation has outmoded this kind of wasteful over-motoring. Motors insulated with Dow Corning Silicones have a service factor of 25 to 50% . . . so now you can merely match your average load, and let this *built-in* service factor handle intermittent overloads.

Lower your motor costs! For every dollar wasted on unused motor capacity, you spend an additional $3 for starters, cable, transformer capacity and installation. Silicone insulated motors *save* you real money!

Boost your production! Motors insulated with Dow Corning Silicones have much greater resistance to heat, moisture, and corrosive atmospheres . . . assure *more continuous production.*

Remember, over-motoring is outmoded

Get sources for silicone insulated equipment—mail coupon today

Dow Corning Corporation, Dept. 6917, Midland, Mich.

Please send me sources for Silicone insulated
☐ Motor ☐ Transformers ☐ and Reprint
"New Developments in Silicone Insulation."

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____

Here's more proof for you...

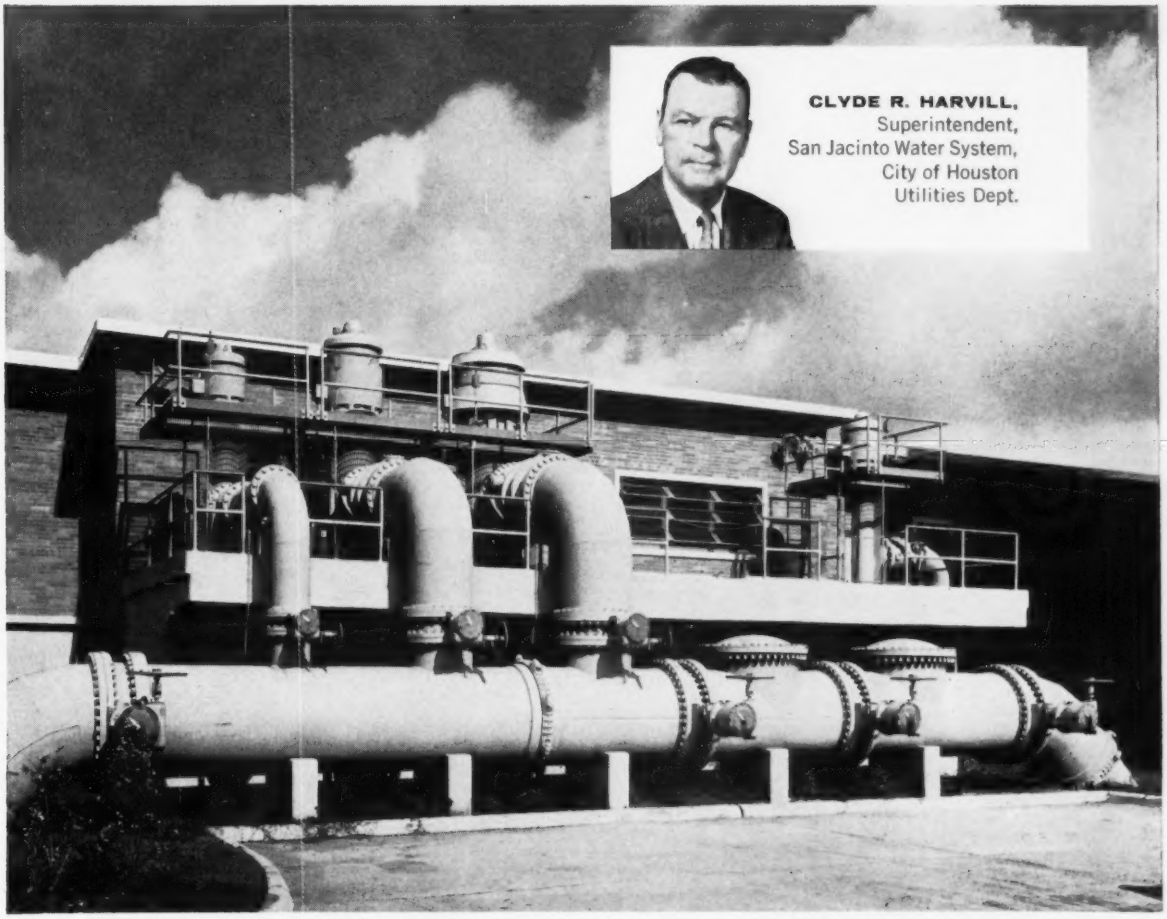
The Philip Sporn plant on the American Gas and Electric System installed its first silicone insulated motor over 6 years ago . . . a 1000 hp, 1190 rpm forced draft fan motor built by the Elliott Co. Smaller and less costly to install than an equivalent 1500 hp conventional motor, this unit has been operating in ambient temperatures up to 120 F without a sign of failure to date. Starting against cold air 4 times a day, it is overloaded by 30% bringing its total rise to 250 F with an output of 1300 hp. This kind of dependable performance has led American Gas and many other leading utilities to standardize on silicone insulated auxiliary motors.

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT
LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris



CLYDE R. HARVILL,
Superintendent,
San Jacinto Water System,
City of Houston
Utilities Dept.

The Houston Water Purification Plant was one of the first plants to use rubber-seated butterfly valves in filter service. Freese, Nichols and Turner, Consulting Engineers, chose R-S Rubber-Seated Butterfly Valves over conventional gate valves for all low-pressure service because their compact design permitted close coupling of pipe. Result: a substantial saving in space, and a direct, in-place cash saving of $124,000.

Houston, Texas, Reports: COMPLETELY SATISFIED WITH R-S BUTTERFLY VALVE OPERATION

When the Houston Purification Plant went into operation in 1954, 65 R-S Rubber-Seated Butterfly Valves were used to equip the entire low pressure system. Today, Mr. Harvill reports that these valves are giving good service, and that he is fully satisfied with their performance and minimum maintenance requirements during their first years of operation.

R-S Rubber-Seated Butterfly Valves are easy to operate, and will provide 100% effective shut-off with a 125-pound pressure drop. Wedging action of the vane against the tough, flexible rubber seat assures positive closure, even around shaft bosses. The special composition of rubber and other materials gives long wear and resistance to the abrasive action of material flow.

To obtain complete information on the full SMS line – Butterfly Valves, Rotovalves and Ball Valves – see our local representative, or write S. Morgan Smith Company, York, Penna.

S. MORGAN SMITH HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

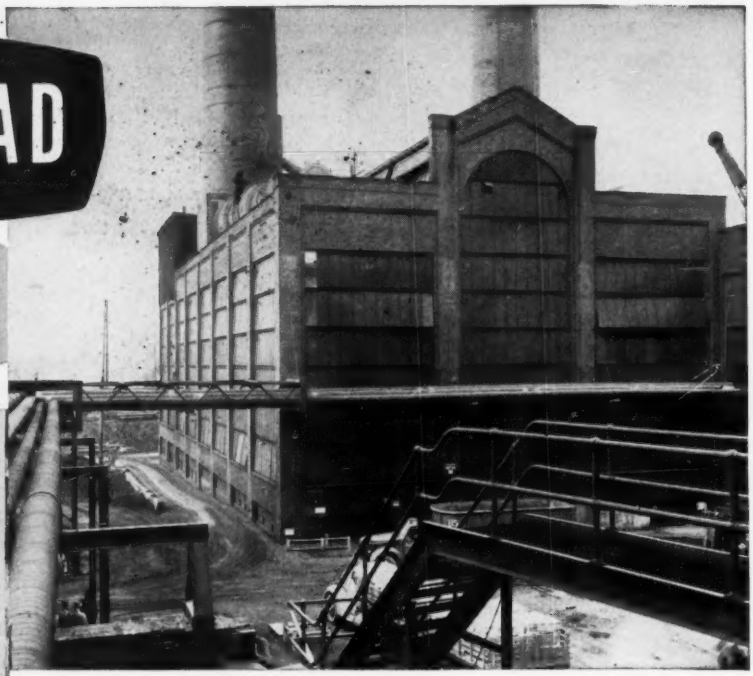
1

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

OVERHEAD

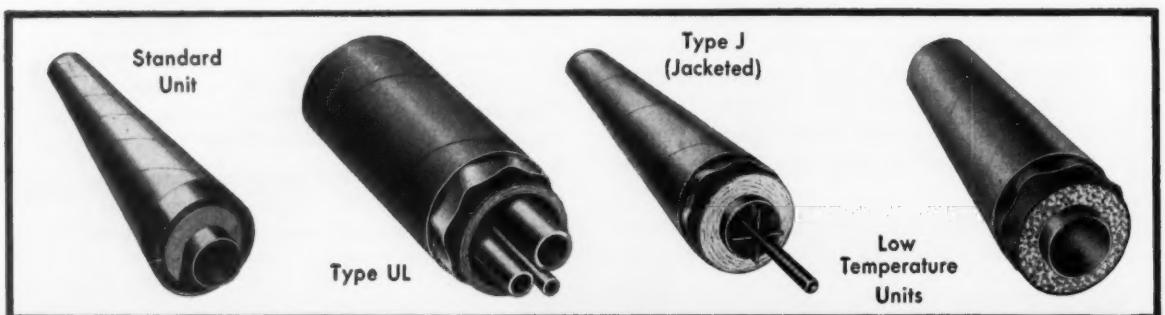
OR

underground



Ric-wiL offers the COMPLETE quality line of prefabricated piping systems

Ric-wiL factory prefabricated piping systems, *timed* to your schedule and *shipped* directly to the job site, can save you valuable time and money. Insulated units are available for steam, hot water, oil, other viscous fluids, process liquids and refrigeration lines . . . and remember . . . Ric-wiL is the quality system of exceptionally high mechanical strength and thermal efficiency.



Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL INCORPORATED
PREFABRICATED INSULATED PIPING SYSTEMS
BARBERTON, OHIO
IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

Write for a copy of the new Ric-wiL Catalog . . .

(Advertisement)

GAS CLEANING NEWS

Eastern Public Utility Installs Two More Koppers Electrostatic Precipitators to Remove Fly Ash

Major Utility has installed 8 Koppers Electrostatic Precipitators since 1947

YEARS of cost-saving, highly efficient performance preceded this latest installation of Koppers Electrostatic Precipitators. During these years, this leading Eastern public utility was able to judge Koppers by on-the-job operation—the most positive proof of performance.

Proves Performance on the Job

Ten years ago, this company purchased its first two Koppers Electrostatic Precipitators for fly ash removal. Satisfactory performance and low maintenance costs justified the purchase of additional Koppers units that were installed in a total of 4 stations. The eight units furnish highly effective, trouble-free operation in a varying range of CFM capacities.

Supplies a Wide Range

The eight Koppers Electrostatic Precipitators serve boilers ranging in capacity from 570,000 #/hr to 950,000 #/hr. Guaranteed efficiency runs as high as 98%, depending on the need of each application. This ability to engineer for a wide range of capacities enables Koppers to satisfy the needs of each station.

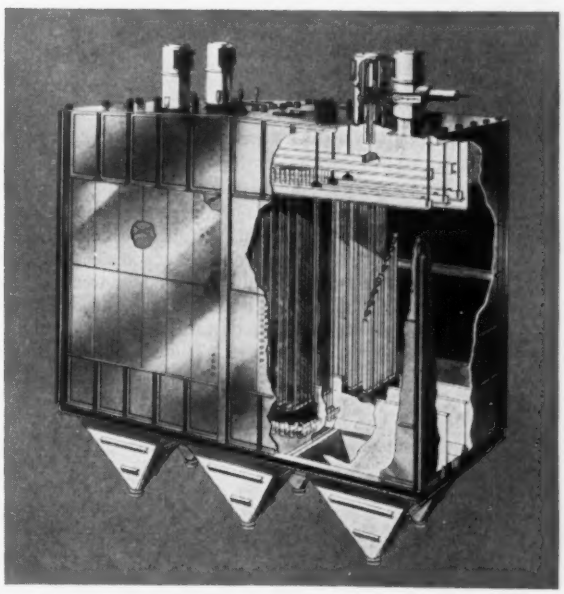
Meets Individual Plant Needs

Koppers custom-designs each Electrostatic Precipitator. Koppers units remove boiler fly ash before the flue gas is discharged from the stack. In designing Electrostatic Precipitators, Koppers utilizes its knowledge of the characteristics of various coals, types of boilers and methods of firing.

Backed by Know-How

Koppers gas cleaning experience goes back 75 years. This experience is backed up by extensive research facilities at Verona, Pa., and Baltimore, Md. From this experience and research has come gas cleaning equipment for all sizes and types of plants.

Get the most out of your gas cleaning dollar. Write KOPPERS COMPANY, INC., Metal Products Division, Industrial Gas Cleaning Dept., 4805 Scott Street, Baltimore 3, Maryland.

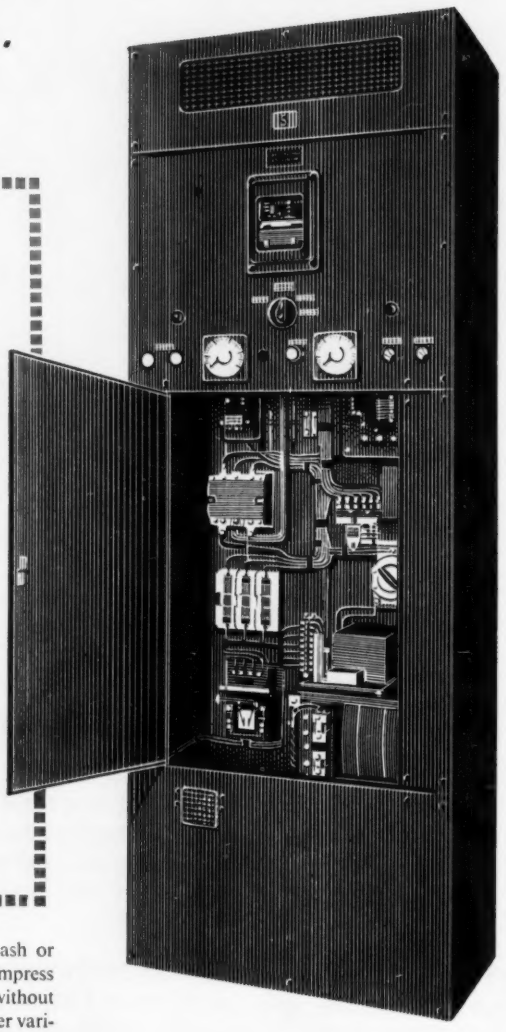


This cutaway photo of a Koppers Electrostatic Precipitator shows shell, vibrators, and collecting and discharge electrodes. The actual design and arrangement of elements vary widely because Koppers Electrostatic Precipitators are custom-engineered to fit the requirements of each installation.

New Automatic Precipitator Control by

WESTERN PRECIPITATION

offers many vital advantages...



1 LONG LIFE

This new control has indefinite life expectancy under all types of operating conditions. There are no tubes to replace, no high speed relays, counters, or timers to maintain. All circuitry consists of rugged "static" devices that have unusually long life!

2 RELIABILITY

Optimum Precipitator power input is maintained regardless of operating conditions. The sensing control is simple, positive, accurate—and automatically evaluates the spark "Power Value" (intensity and frequency)—not just frequency or intensity alone.

3 STABILITY

Under short circuit, open circuit or other varying conditions, this control is completely stable and inherently trouble-free!

4 MODEST COST

Modest initial cost coupled with negligible maintenance assure optimum operating efficiency (therefore lower operating costs) throughout many years of continuous service.

WHEN using a Cottrell Precipitator for collecting dust, fume, fly ash or other suspensions from industrial gases, it is essential at all times to impress on the high voltage system the highest possible voltage and current without "flashover". Depending upon gas conditions, dust loading and other variable factors, the optimum voltage and current requirements vary widely from one minute to the next. Therefore, the vital importance of a simple, trouble-free and highly sensitive Precipitator Control is self-evident.

This new Western Precipitation Automatic Precipitator Control—*a product of the organization that has consistently led in the application of Cottrell Precipitators for industrial gas cleaning*—combines vital advantages found in no other competitive equipment. Our nearest representative will be glad to supply complete details. Or write direct!

Why not modernize your present out-dated Precipitator installation? The Western Precipitation Automatic Precipitator Control can be installed on any Cottrell unit. For further information contact our nearest office!

Western Precipitation Corporation

Designers and Manufacturers of Equipment for Collection of Suspended Material from Gases ..and Equipment for the Process Industries

Main Offices: **1049 WEST NINTH STREET, LOS ANGELES 54, CALIFORNIA**

Chrysler Building, New York 17 • 1 North La Salle Street Building, Chicago 2 • Oliver Building, Pittsburgh 22 • 3252 Peachtree Road N. E., Atlanta 5 • Hobart Building, San Francisco 4

Precipitation Company of Canada Ltd., Dominion Square Building, Montreal

Representatives in all principal cities

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Reverse-Jet Filters
HOLO-FLITE Processors

5086

HIGHEST STRENGTH ALUMINUM FOR UNFIRED PRESSURE VESSEL FABRICATION

Kaiser Aluminum now offers you alloy 5086 . . . the highest strength aluminum alloy available for the fabrication of unfired pressure vessels.

Non-heat-treatable 5086 is designed specifically for welded structures requiring maximum joint strength and efficiency, plus light weight and corrosion resistance.

And, with high-strength 5086 you can take advantage of inert-gas, shielded-arc welding methods for faster welds and pressure tight joints.

Development of 5086 by Kaiser Aluminum makes possible many new applications of light weight, durable aluminum for the chemical and petroleum industries. Find out now how this versatile alloy can serve you.

For complete information, call the Kaiser Aluminum sales office listed in your phone directory. Process Industries Department, Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois; *Executive Office*, Kaiser Bldg., Oakland 12, California.

PHYSICAL CHARACTERISTICS OF ALLOY 5086

Typical mechanical properties in various tempers

	Temper			
	"0"	H32	H34	H112
Tensile strength (psi)	38,000	42,000	47,000	39,000
Yield strength (psi)	17,000	30,000	37,000	19,000
Elongation (% in 2")	22	12	10	14

Allowable design stress values

	For metal temperature not exceeding deg. F.	
Condition (temper)	100°	150°
Annealed	8700 psi	8700 psi
H112	8700	8700
H32	10,000	9900
H34	11,000	10,800

Allowable stress values for welded construction compared with other alloys

Alloy Designation		For metal temperature not exceeding 150° F. (annealed condition)
AA	ASTM	
1160	996A	1650 psi
1100	990A	2350
3003	M1A	3150
3004	MG11A	5650
5050	G1A	4000
5052	GR20A	6250
5154	GR40A	7350
5086	GM40A	8700

Nominal composition

4.0% magnesium
0.45% manganese
0.10% chromium

Typical weld strengths (specimens tested across the weld)

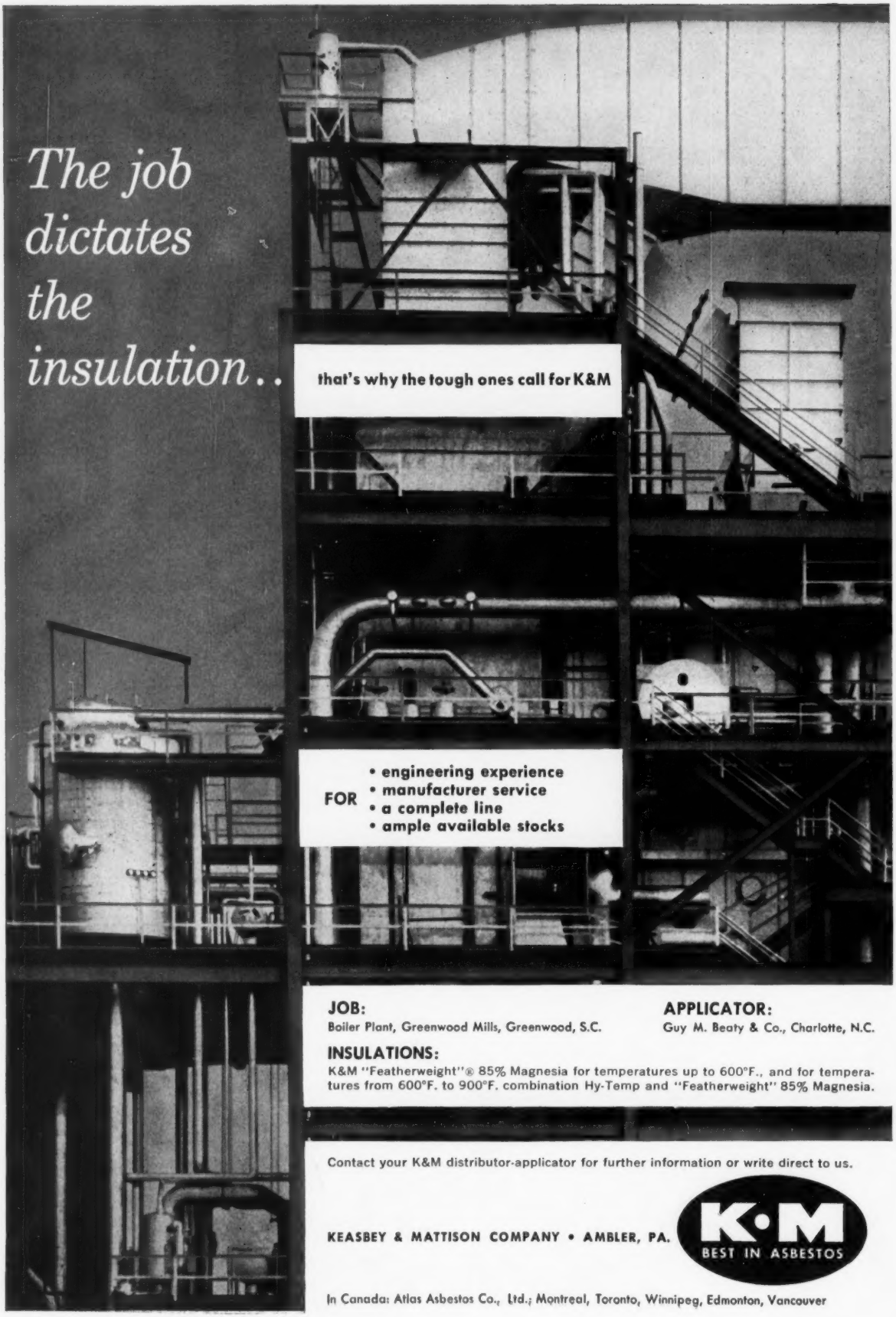
37,000 psi tensile strength
18,000 psi yield strength
13% elongation

Kaiser aluminum 5086 is available in flat and coiled sheet, plate and extrusions.

Kaiser Aluminum

materials for the process industries

See "THE KAISER ALUMINUM HOUR." Alternate Tuesdays, NBC Network. Consult your local TV listing.



The job dictates the insulation..

that's why the tough ones call for K&M

FOR
- **engineering experience**
- **manufacturer service**
- **a complete line**
- **ample available stocks**

JOB:
Boiler Plant, Greenwood Mills, Greenwood, S.C.

APPLICATOR:
Guy M. Beaty & Co., Charlotte, N.C.

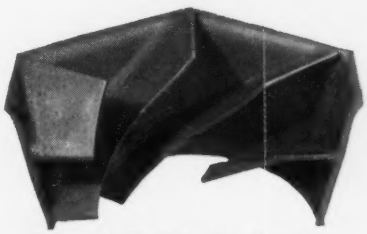
INSULATIONS:
K&M "Featherweight"® 85% Magnesia for temperatures up to 600°F., and for temperatures from 600°F. to 900°F. combination Hy-Temp and "Featherweight" 85% Magnesia.

Contact your K&M distributor-applicator for further information or write direct to us.

KEASBEY & MATTISON COMPANY • AMBLER, PA.

K·M BEST IN ASBESTOS

In Canada: Atlas Asbestos Co., Ltd.; Montreal, Toronto, Winnipeg, Edmonton, Vancouver



Selective Particle Acceleration

Inlet cell vane design produces smooth, even deflection and controlled acceleration of air stream. Smaller lighter dust particles pick up speed quickly, larger particles accelerate more slowly. Both attain enough velocity for good separation, but not enough to cause erosion damage. This is the Hagan principle of Selective Particle Acceleration.

Installation of fully pre-assembled Hagan Dust Collector

Minimum erosion, fast installation...

HAGAN MECHANICAL DUST COLLECTOR

Fast installation is one of the features of the new Hagan Dust Collector. Recently a collector for a 75,000 lb/hr boiler was erected in less than fourteen hours. With the duct work connected up, it was ready to go.

The Hagan vaned-nozzle inlet design has practically eliminated tube erosion and collection efficiencies are raised, because of high effectiveness in the 1 to 10 micron range. Check these cost and trouble-saving features:

- Tube erosion virtually eliminated. Hagan Dust Collectors are *guaranteed* against tube failure due to erosion *for two full years.*
- Pressure drop 20% lower than conventional multiple tube collectors based on same efficiency.
- Hexagon shaped tops—This honeycomb shape permits close tube packing, eliminates dust trapping and clogging.
- Easy maintenance—Ease of access to all parts makes the Hagan Dust Collector easy to inspect.
- Lower overall height requirements.

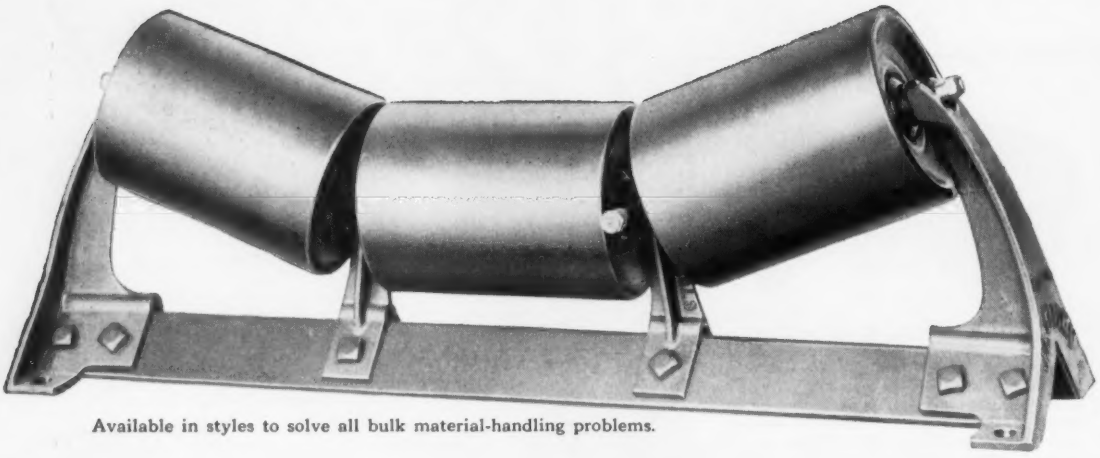
Add to these the fact that the Hagan Dust Collector's efficiency easily meets the most rigid existing code requirements for coal fired boilers for any city in the United States.

Write for specifications, or a Hagan engineer will be glad to discuss your particular requirements.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

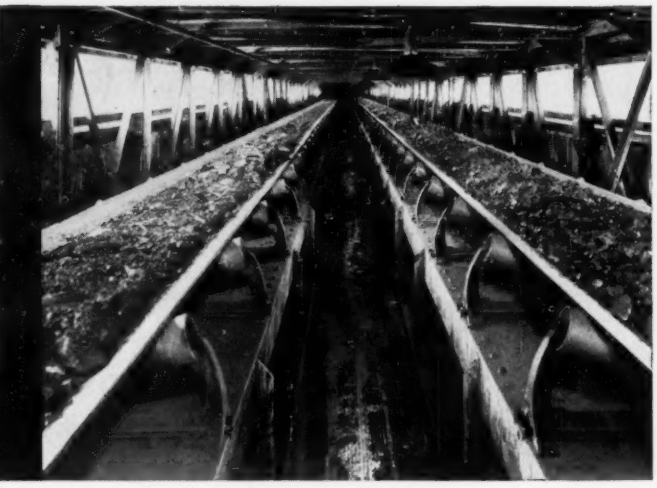


Available in styles to solve all bulk material-handling problems.

for heavy handling under adverse conditions

JEFFREY BELT IDLERS

Jeffrey idlers awaiting installation on a cross-country coal conveyor from mine to power plant.



and at work on a heavy hauling job.

Jeffrey idlers offer every feature essential to belt protection, dependability and long service. Equipped with roller bearings, these idlers assure maximum efficiency and economy of conveyor belt operation.

The outer shell of the rolls is made of high-quality steel tubing, into which the ends are carefully centered and welded, forming a one-piece balanced roll. Corners are rounded to prevent injury to the belt. The sturdy, malleable-iron stands are die straightened to assure proper alignment and snugness of fit.

All parts of the Jeffrey idler are interchangeable. Idlers and parts are always available, ready for shipment from factory or distributor stock. The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT •
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

Spiral-Bevel Cooling TOWER DRIVE

simple
compact
sturdy
efficient

Here are features which make these single reduction Spiral-Bevel Units outstanding:

- High Efficiency . . . 97, 98% with small heat loss.
- Precision generated Spiral-Bevel Gears, case hardened for long service life.
- Heavy duty housing construction.
- High dome permits mounting fan directly on unit, with ample clearance below fan blades.
- Spiral-bevel pinion is supported by additional outboard bearing, thus preventing any possible pinion deflection.
- Oversize bearings give extra long life.
- Top bearing is continually flooded with oil—no grease fittings are necessary.
- Economical to operate.
- Reducer meets all AGMA standards.

These widely used Cooling Tower Drives are made in 5 sizes, rated from 15 h.p. to 75 h.p. at 1750 r.p.m. motor speed, with Ratios ranging from 3½ to 9½:1.

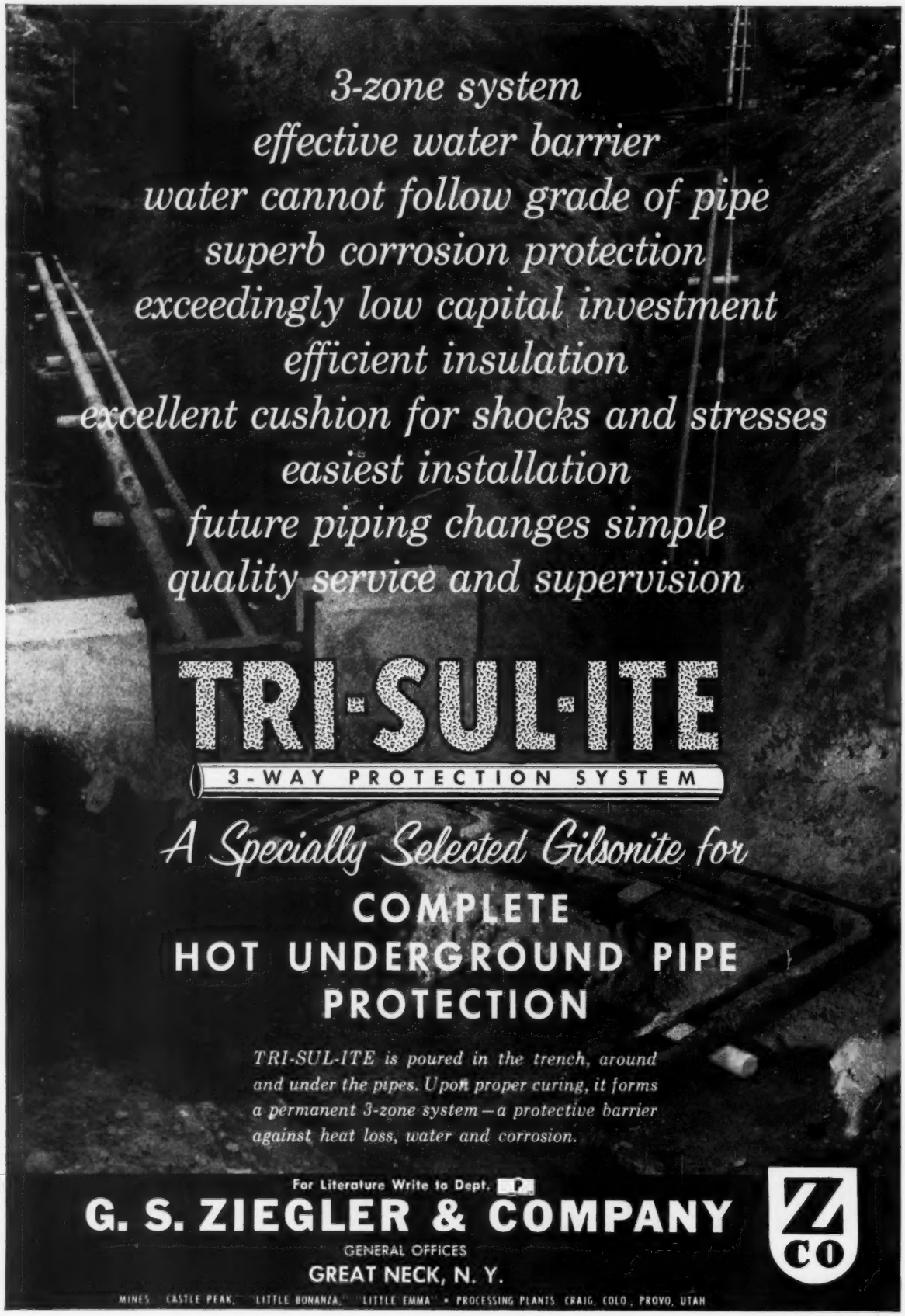
Be sure your next Cooling Tower is equipped with this dependable Philadelphia Drive. Literature upon request.

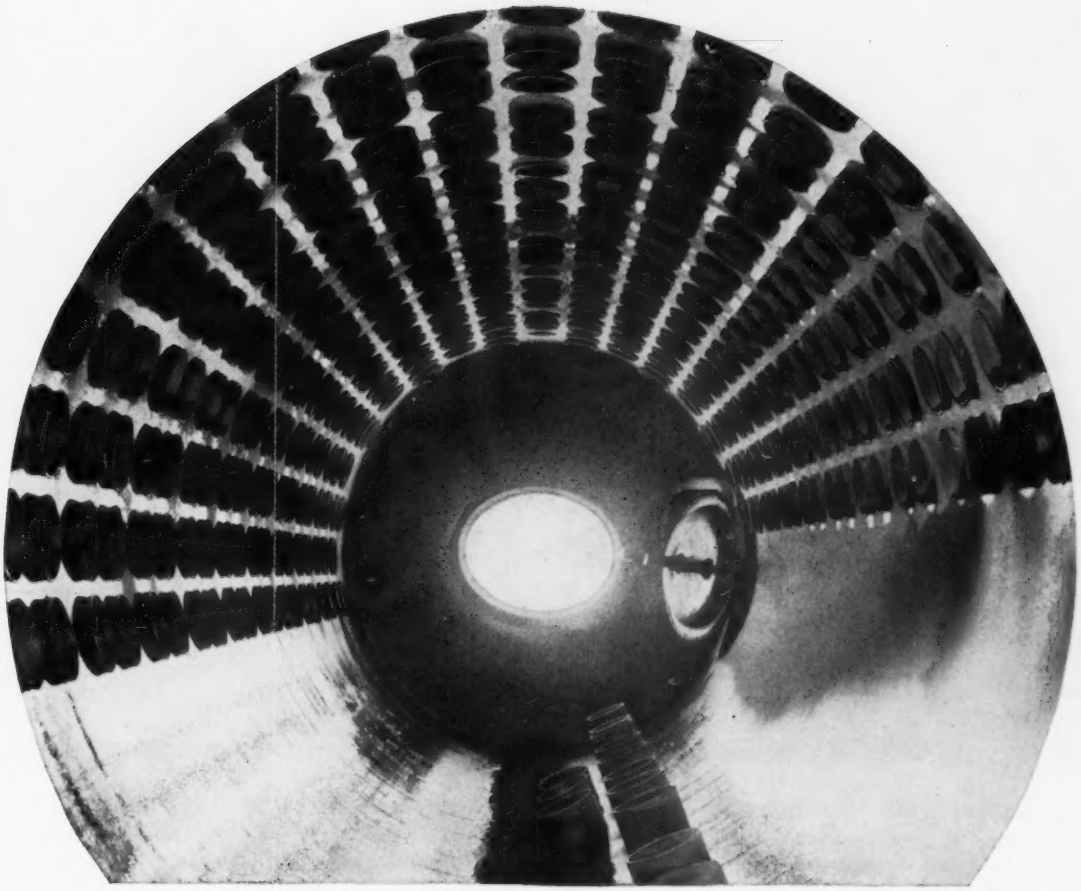
Write for Catalog CT-53, which illustrates and fully describes all types of Philadelphia Cooling Tower Drives and their applications: Spiral Bevel, Helical-Spiral Bevel and Worm Gear.

phillie gear®

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS
Virginia Gear & Machine Corp. • Lynchburg, Va.


3-zone system
effective water barrier
water cannot follow grade of pipe
superb corrosion protection
exceedingly low capital investment
efficient insulation
excellent cushion for shocks and stresses
easiest installation
future piping changes simple
quality service and supervision
TRI-SUL-ITE
3-WAY PROTECTION SYSTEM
A Specially Selected Gilsonite for
COMPLETE
HOT UNDERGROUND PIPE
PROTECTION
TRI-SUL-ITE is poured in the trench, around and under the pipes. Upon proper curing, it forms a permanent 3-zone system—a protective barrier against heat loss, water and corrosion.
For Literature Write to Dept. P
G. S. ZIEGLER & COMPANY
GENERAL OFFICES
GREAT NECK, N. Y.
MINES CASTLE PEAK, "LITTLE BONANZA," "LITTLE EMMA" • PROCESSING PLANTS CRAIG, COLO., PROVO, UTAH
ZCO



NOBODY WAS SURPRISED

When this mud drum was opened for inspection, it looked just as everyone expected it would—clean as a whistle, completely free of sludge and scale—after nine months of treatment with Dearborn Formula 659. That's product dependability.

Formula 659 contains a patented* Dearborn Polyamide Anti-Foam that provides protection throughout the entire water-steam cycle. In addition to improving steam quality, Formula 659 also conditions sludge, reduces blowdown requirements, and controls corrosion.

Compatible with other water treating reagents, Formula 659 is a neutral product which imparts no alkalinity to boiler water—nor will it increase carbon dioxide content of steam.

Formula 659 will mean important savings in your plant—see your Dearborn Engineer.

**U.S. Pat. No. RE-23085*

HOW FORMULA 659 WORKS

FORMULA 659 improves steam quality by reducing carry-over to a minimum.

FORMULA 659 keeps sludge in a fluid, non-adherent form.

FORMULA 659 permits higher boiler water concentrations, thus reducing blowdown.

FORMULA 659 helps protect against corrosion in the water-steam cycle.

USE THE COUPON

Dearborn®

...a leader in water conditioning and corrosion control for 70 years

Dearborn Chemical Company, Dept. PO
Merchandise Mart Plaza, Chicago 54, Ill.

☐ Send complete details on Dearborn Formula 659.

Name.....*Title*.....

Company.....

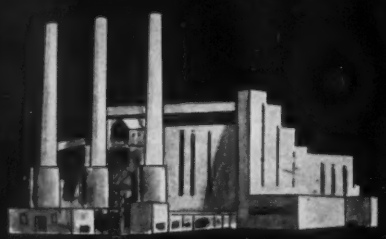
Address.....

City.....*Zone*.....*State*.....

GET GREATER SAFETY AT LOWER COST...

CHOOSE THE TYPE 1511

CONSOLIDATED SAFETY VALVE



TYPE 1511 CAST IRON BODY SAFETY VALVE
SIZES: 1½" through 6". **PRESSURES:** up to 250 psi. **TEMPERATURES:** up to 450° F. All sizes except 6" available with oversize flanges.

Maximum safety comes first in power engineering. But lower initial equipment investment and lower maintenance costs are also essential factors. The Type 1511 Consolidated Safety Valve gives you all three. It is an all-purpose safety valve, expressly designed for steam generator service, yet costs less than other makes for the same service.

Among the many advantages of the Type 1511 are:

1	Positive tightness because the seat is precision lapped to optical flatness.
2	Stable operation and uniform blowdown control because the spring is exposed.
3	Better alignment, easier blowdown adjustment and finer performance because the valve has an integral, double-guided combination adjusting ring and disc guide.
4	Cuts the cost per pound of steam discharged because maximum capacity is designed into minimum flange size. The size and/or number of safety valve nozzles required on any boiler are reduced.
5	Saves space – requires less headroom and smaller discharge piping.

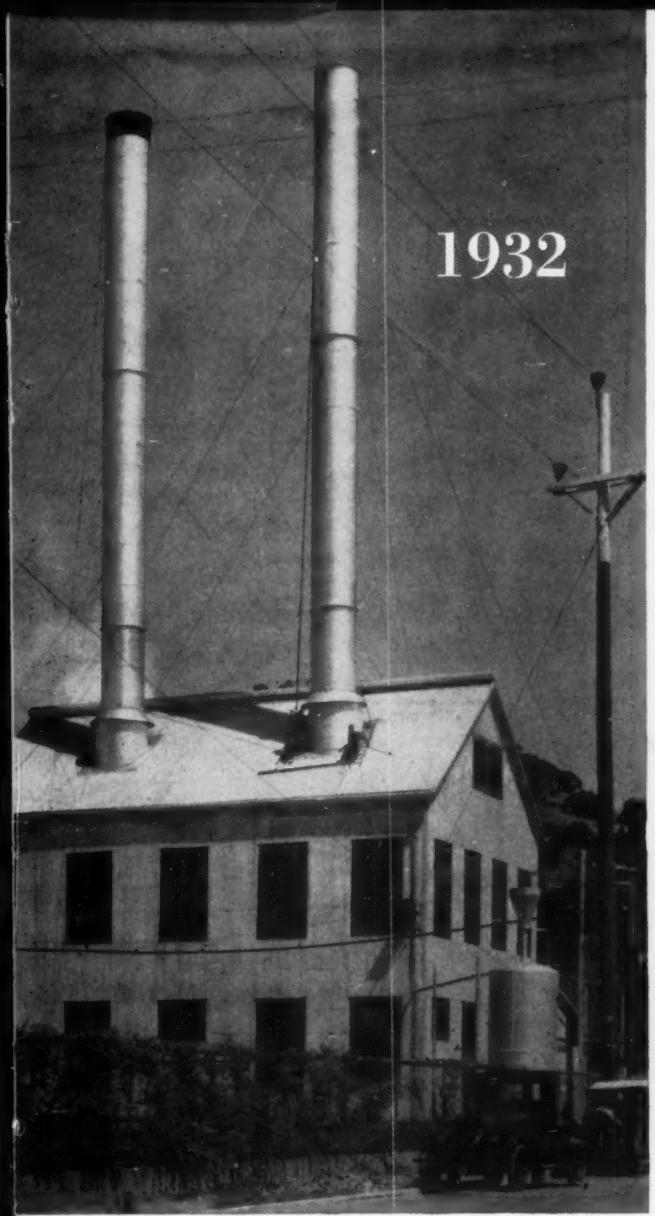
The Type 1511 Consolidated Safety Valve is made in a full range of sizes and orifices. Write for Bulletin 730 and learn the complete story of the greater safety and economy of the Type 1511.

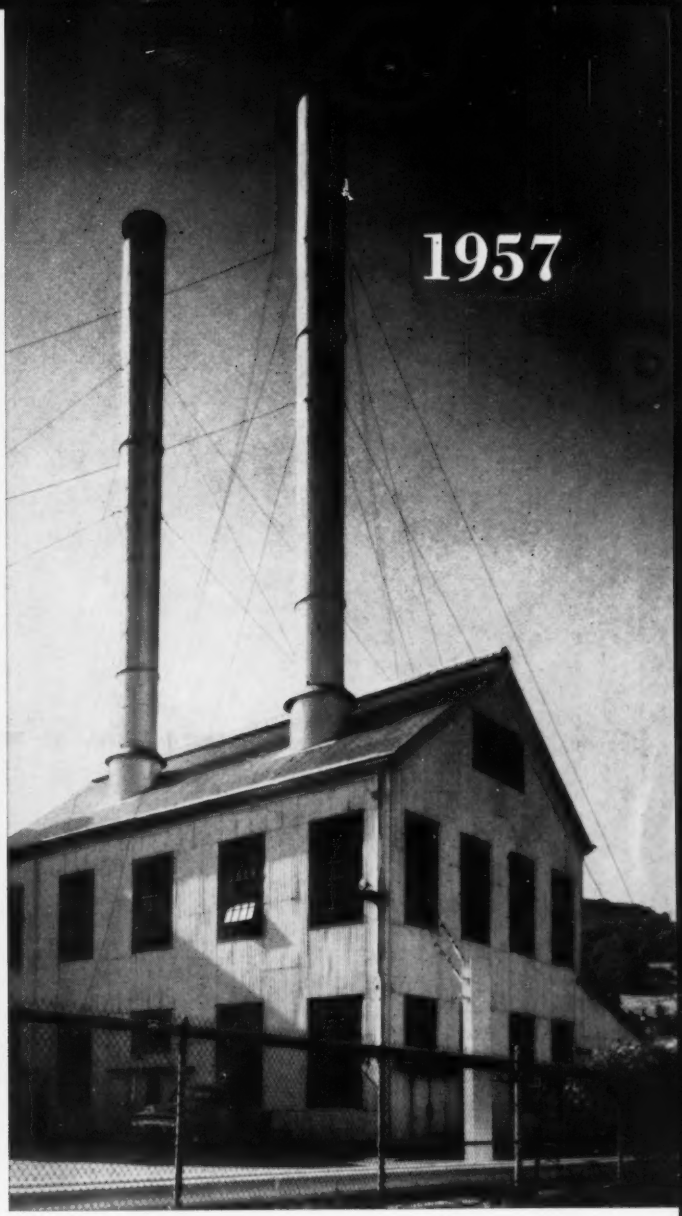
In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario.*

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, CONSOLIDATED SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*





Installed 25 years ago... still in excellent condition... here's another Wrought Iron Plate durability story

After twenty-five years of service over boilers, these wrought iron stacks still rate a "no maintenance needed" inspection report.

These stacks, installed at San Rafael, California, Gas Plant of Pacific Gas & Electric Company, tell the kind of story repeated over and over again whenever wrought iron is used. It's a story of economy made possible because of wrought iron's unique defense against flue gas corrosion.

Byers wrought iron plate is an old campaigner in stack service. You'll find documented evidence of its endurance in our bulletin, *Wrought Iron for Flue Gas Conductors and Coal Handling Equipment.* Clear up a lot of questions about stack maintenance. Write us today for this helpful aid . . . it will pay you.

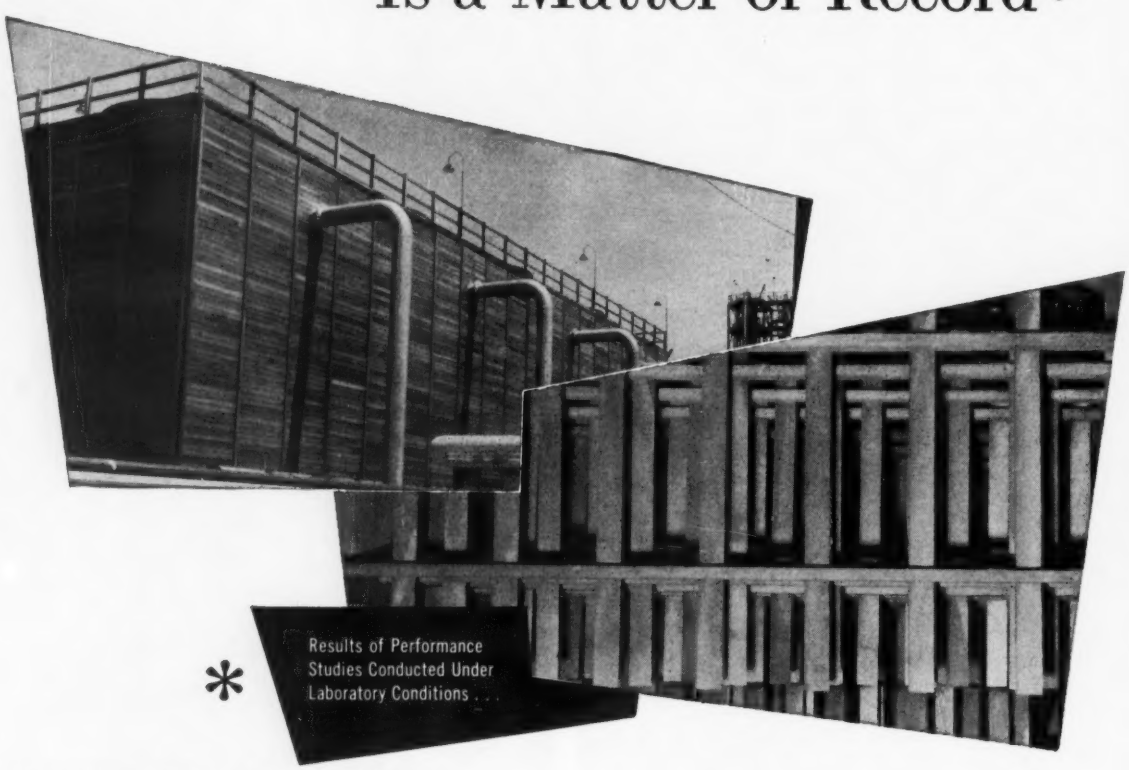
A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N.Y.

Available in Canada and throughout the world

BYERS *Wrought Iron Tubular and Hot Rolled Products*

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

The Superiority of Pritchard Cooling Tower Filling Is a Matter of Record*



* Results of Performance Studies Conducted Under Laboratory Conditions . . .

AND CONFIRMED IN THE FIELD

After all, it's the performance of a cooling tower that counts most in the final analysis. And, the performance of any cooling tower is dependent upon the efficiency of the packing or filling used in the tower.

Results of recent performance studies, which tested all types of cooling tower deck filling known to be in use in counter flow cooling towers, justify Pritchard's statement that, "Pritchard Cooling Tower Fill Is Superior."

The Results of These Tests Are Available to You . . . in an article titled "Comparative Performance of Cooling Tower Packing Arrangement," reprinted from a recent issue of a leading trade journal. We would be pleased to send you a FREE copy of this study. Just a note on your company letterhead will do.

Another FREE Offer! In addition to the paper on "Comparative Performance of Cooling Tower Packing Arrangement," you will most likely want a copy of "ANSWERS TO 15 QUESTIONS ABOUT PRITCHARD INDUCED DRAFT COOLING TOWERS." This fascinating brochure will be invaluable to you in helping you select the proper cooling tower for your specific needs. This, too, is yours for the asking—no cost, no obligation.

SEND FOR BOTH, TODAY!

INDUSTRY'S PARTNER FOR PROGRESS

COOLING TOWERS
GAS & AIR TREATING EQUIPMENT

REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

J.F. Pritchard & Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 576, 4625 Roanoke Parkway, Kansas City 12, Mo.

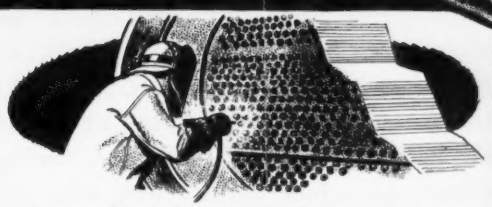
POWER POINTERS

IT'S CURTAINS

FOR FLUE-GAS CONTROL PROBLEMS

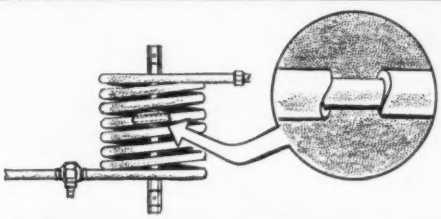
...0.005-INCH INCONEL ALLOY CURTAINS

FLUE GASES...UP TO 800°F...WERE TOO HOT FOR REGULAR ASBESTOS DAMPER CURTAINS IN ONE ELECTRIC COMPANY BOILER. SO THE CURTAIN MANUFACTURER DESIGNED ONE MADE OF METAL. IT HAS THE SAME WINDOW-SHADE ACTION; THE SAME FLEXIBILITY. BUT IT'S MADE OF 0.005-INCH THICK INCONEL* NICKEL-CHROMIUM ALLOY SHEET. THREE YEARS OF ASH-LADEN STACK GASES HAVEN'T CORRODED OR WORN THE INCONEL CURTAIN TO ANY NOTICEABLE DEGREE.



New all-welded high-pressure feedwater heater

THIS NEW, ALL-WELDED FEEDWATER HEATER ENCOUNTERS PRESSURES TO 3600 PSI...INLET STEAM TO 790°F. TO INSURE RELIABLE OPERATION, "140" MONEL* NICKEL-COPPER ELECTRODES WERE USED TO WELD ITS FOOT-THICK STEEL TUBE SHEETS TO COPPER-NICKEL TUBES. THE HIGH NICKEL CONTENT OF THIS ELECTRODE MAKES POSSIBLE DUCTILE, NON-POROUS WELDS THAT STAY STRONG UNDER SEVERE CONDITIONS.



NEW INNER TUBE FOR STEAM SAMPLER GIVES EXTRA "MILEAGE"

AT A MID-WESTERN POWER PLANT, STRESS-CORROSION CRACKING RUINED INNER TUBES OF HIGH-TEMPERATURE STEAM SAMPLER COILS IN SIX MONTHS OR LESS. A SWITCH TO INCONEL ALLOY HAS TRIPLED INNER TUBE "MILEAGE" EVEN THOUGH THE SAME THERMAL SHOCK AND CORROSIVE CONDITIONS EXIST.

WHAT'S YOUR METAL PROBLEM?

MAYBE AN INCO NICKEL ALLOY CAN REINFORCE YOUR INGENUITY AND LEAD TO A QUICK SOLUTION. TO EXPLORE THE POSSIBILITIES, WRITE FOR INCO BULLETINS COVERING THE ENGINEERING PROPERTIES OF INCONEL AND INCONEL 'X' ALLOYS AND MONEL AND 'K' MONEL ALLOYS.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Nickel Alloys**

*Registered Trademark

A Progress Report on Faculty Salaries:

UP . . . But Not Nearly Enough

THE CHART on this page provides a report of the progress being made in solving a problem of crucial importance to every American. The problem is that of seeing that college and university faculty members get decent salaries.

This new chapter, which brings the story forward two years—from 1954, when it was last dealt with in this series of editorials, through 1956—has a decidedly cheering element. For in the last two years faculty salaries have made real headway.

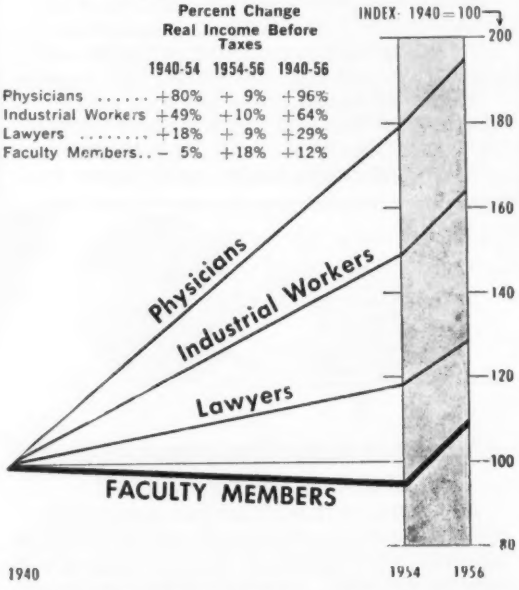
Two Years of Improvement

In 1954, in terms of what their salaries would buy, faculty members as a whole were actually worse off, by 5%, than they had been fourteen years earlier. As the chart shows, over the same period the real income of the average industrial worker had increased by almost half. And, in what it would buy, the income of the average physician, with professional training comparable to that of the average faculty member, had jumped by 80%.

In 1956, however, the average faculty salary would buy about 12% more of goods and services than it would in 1940. Relative to where they were two years before, faculty salaries showed a larger gain over the two years than those of any of the other groups whose salary progress is charted.

This movement of faculty salaries in the right direction has many contributing causes. The biggest single boost was given by the great Ford Foundation gift of half a billion dollars to our colleges, universities, and hospitals, almost half of which was ear-marked for faculty salary increases. Gifts from business firms have also

What is Happening to College Faculty Salaries



DATA: Council for Financial Aid to Education, U. S. Dept. of Commerce, U. S. Dept. of Labor, National Association of Education Research Dept., McGraw-Hill Dept. of Economics.

helped a lot. And so, in many cases, have stepped-up money-raising campaigns by alumni groups and cooperative regional and state groups of colleges.

Still a Long Way to Go

However, faculty salaries started their ascent from such a dismal depth that they still have a long, long way to go up before there is room for the comfortable conviction that they are fair, or even safe, from the standpoint of protecting the nation's vital interests. It still remains possible to find many shocking companion pieces for the following incident recently reported to a McGraw-Hill executive group, working on problems of financial aid to higher education, by the president of an illustrious small liberal arts college.

"The recruiting officer of one of our large industrial companies came to our campus a few weeks ago," the college president said, "and offered five of our seniors higher salaries to start working for that company when they are graduated next June than the salary received by any member of our faculty. And the seniors, of course, promptly went to their professors to seek advice on whether or not they should accept. It doesn't take much imagination to see what this sort of thing does to the morale of a faculty."

Senior Teachers Fare Badly

One of the more devastating things it does, of course, is to make the more experienced college and university faculty members receptive to the idea of going to greener pastures, currency-wise, in business and industry.

For these senior faculty members the financial pounding in the past 16 years has been even worse than the chart indicates. While the average real salary gain reported by the chart has been 12%, the average salary of a full professor still buys less than it did in 1940. This is because most of the salary increases have gone to beginning instructors, for whose services industry has been providing the sort of competition reported by the liberal arts college president.

And it creates this financial lackluster of posts as senior college faculty members right at the time their services are needed more than ever to handle the oncoming flood of college and university students. Between now and 1970 college and university enrollment is expected to double.

What is Needed Now

What is clearly needed is a continuation and intensification of the drive to increase their salaries to a point where college and university faculty members will be sharing somewhere near fully in the general prosperity of the nation. It could be counted good progress in this direction if over the next two years faculty salaries on the average were to go up another 12%, with most of the increase concentrated in the senior faculty ranks. And this can be made possible only through more outside contributions.

There is reason to be encouraged by the progress that has been made over the past two years in bailing college and university faculty members out of the terrible financial hole into which they were allowed to slide. But there is the most urgent occasion to keep at it and harder.

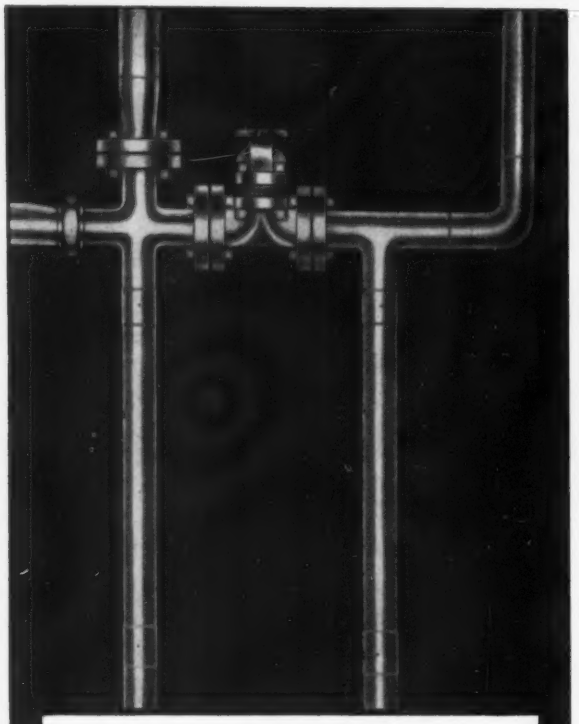
This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.



PIPELINE ECONOMY
BEGINS AT THE FITTINGS!

Only *Speedline* Corrosion-Resistant Fittings permit

- Multiple choice of joint with *every* fitting—*on the job!*
- Time and cost saving design and assembly for *any* piping installation!
- Use of *low cost*, light wall Schedules 5 and 10 stainless pipe!

"Speedline Catalog" describes important cost saving advantages for *your* application. Request a copy at no obligation.

SPEEDLINE IS A REG. T.M. OF HORACE T. POTTS COMPANY

Speedline®

104

STAINLESS STEEL FITTINGS

THE NEWEST THING IN PIPELINE ECONOMY

SPEEDLINE DISTRIBUTORS ARE LOCATED IN PRINCIPAL CITIES FROM COAST TO COAST

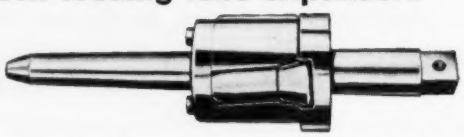
Manufactured by **HORACE T. POTTS COMPANY**
568 E. Erie Avenue • Philadelphia 34, Penna.

Keep boilers on the line with
WILSON
Maintenance Tools

Heavy-duty air driven tube cleaners

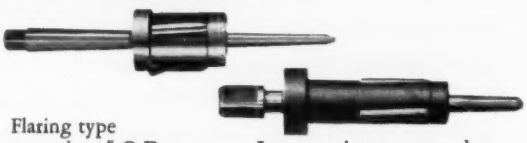
Designed to deliver maximum power at the most efficient cutter head speeds while negotiating sharp bends, the Model ECT Air Cleaners are excellent for cleaning curved boiler tubes from 2½″ to 4½″ O.D.

Self-feeding tube expanders



Wilson Model 38 tube expanders are self-feeding and parallel expanding. They are of the single flare roll type. Available for tubes 1″ O.D. to 4½″ O.D. with various roll lengths for tube seats ¾″ and up.

Model E Expanders



Flaring type expander 1″ O.D. to 4½″ O.D. tubes, ½″ to 2″ tube seats

Long reach type expander 1″ O.D. to 4½″ O.D. tubes, 2½″ to 5″ tube seats

Right angle bevel gear drive

This Wilson bevel gear drive is expressly manufactured to meet continuous and heavy duty service conditions. The one piece all steel body is extremely rigid and not subject to distortion. The maintenance of perfect gear alignment is assured with consequent long service life.

Write today for your copies of Wilson Tube Cleaner catalog No. 77 and Wilson Tube Expander catalog No. 88.

Representatives in principal cities
Thomas C. Wilson, Inc. • 21-11 44th Ave., Long Island City 1, N. Y.
Cable address: "Tubeclean", New York

WILSON TW870

TUBE CLEANERS • TUBE EXPANDERS

CUT YOUR PRODUCTION COSTS

with

JOHNSON

Pneumatic Control

Johnson Pneumatic Damper Operators control the supply of outdoor air in a central ventilation system.

More and more progressive industrial firms are discovering that providing proper ventilation and comfortable temperatures is an excellent way to reduce costs. Workers automatically respond to comfort by improving production, stepping up efficiency. Absences fall off. So does turnover.

But, even the best, most efficient heating, cooling and ventilating equipment can't produce these conditions without the proper control. That's where a system of Johnson Pneumatic Control can be a big help to you.

Johnson Pneumatic Control does the job you expect because every Johnson System, regardless of its size, is designed and installed to meet the exact needs of the individual plant. *All* phases of the control work—design, installation and service—are handled by Johnson's own engineers and factory-trained mechanics.

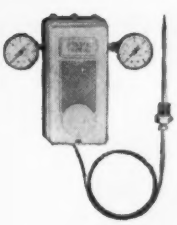
Whether your particular control problems involve comfort conditions or the provision of protective temperatures and humidities for products and processes, Johnson Pneumatic Control is the answer. It's simpler by far than any other method of control—requires fewer components, is easier to operate and maintain, offers the widest choice of operating features.

Why not get started now in adding to your productive efficiency and cutting your operating costs? An engineer from a nearby Johnson branch will gladly make recommendations on any temperature, humidity or pressure control problem without obligation. Johnson Service Company, Milwaukee 1, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON CONTROL

SINCE 1885

PLANNING • MANUFACTURING • INSTALLING

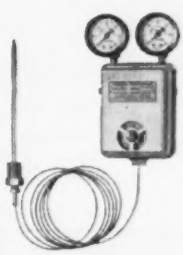


T-900
Master Thermostat

T-901
Submaster Thermostat

V-103
Globe Valve

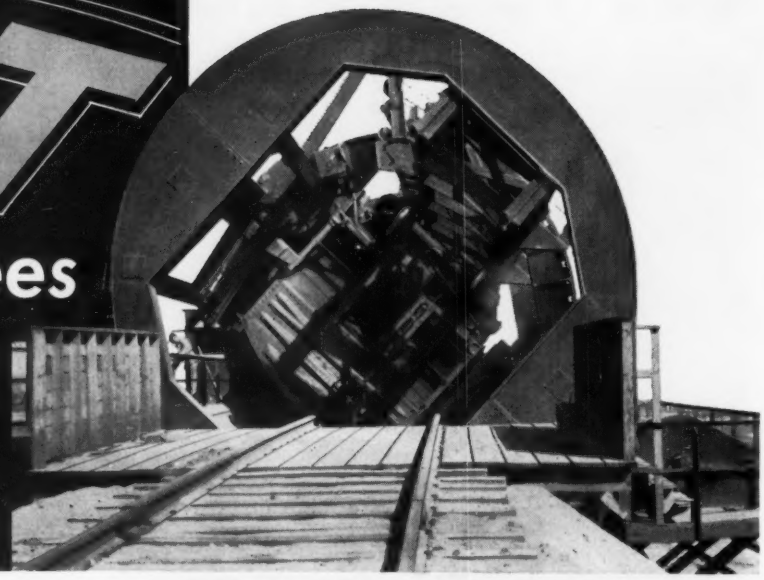
R-1051
Static Pressure Regulator



T-800
Remote Bulb Thermostat

TILT
180 Degrees

SIMPLIFIED MECHANISM COMPLETES THE DUMPING CYCLE IN 90 SECONDS!



RAILROAD CAR DUMPERS by EASTERN

■ *Write for Bulletin 200*

CONSTRUCTORS, INC.
Poland, Ohio

A Complete Combustion Efficiency Test In 30 Seconds With the NEW, Low-Cost

DWYER COMBUSTION TEST KIT (No. 1100)

Dwyer CONTROLS GAGES

- *SIMPLE TO USE*
- *LIFETIME ACCURACY*
- *PORTABLE*
- *COMPLETE*
- *INEXPENSIVE*

Includes:

CO_2 Indicator	Smoke Gage
Draft Gage*	Slide Rule Computer
Stack Thermometer	Magneclips
	Instructions

...and all necessary accessories and fittings

Here's everything you need for a thorough, professional job of combustion testing. This new DWYER Kit simplifies the testing of any installation . . . residential, commercial or industrial: gas, oil or coal fired. You can perform a complete analysis in less than 30 seconds . . . *accurate to within* ±½% CO_2.

Handy, handsome metal kit—(also available with CO_2 Indicator alone)—is custom-fitted for all necessary parts and accessories.

*Draft Gage...famous DWYER Inclined Manometer. Continuously indicating type, permanently accurate—choice of ranges: 0 to ¼", 0 to ½", or 0 to 1" water.

Write for complete information

F. W. DWYER MFG. CO.

P.O. BOX 373-J • MICHIGAN CITY, INDIANA

Write for

Power's

REPRINT FOLDER

...SUMMARIES and PRICES

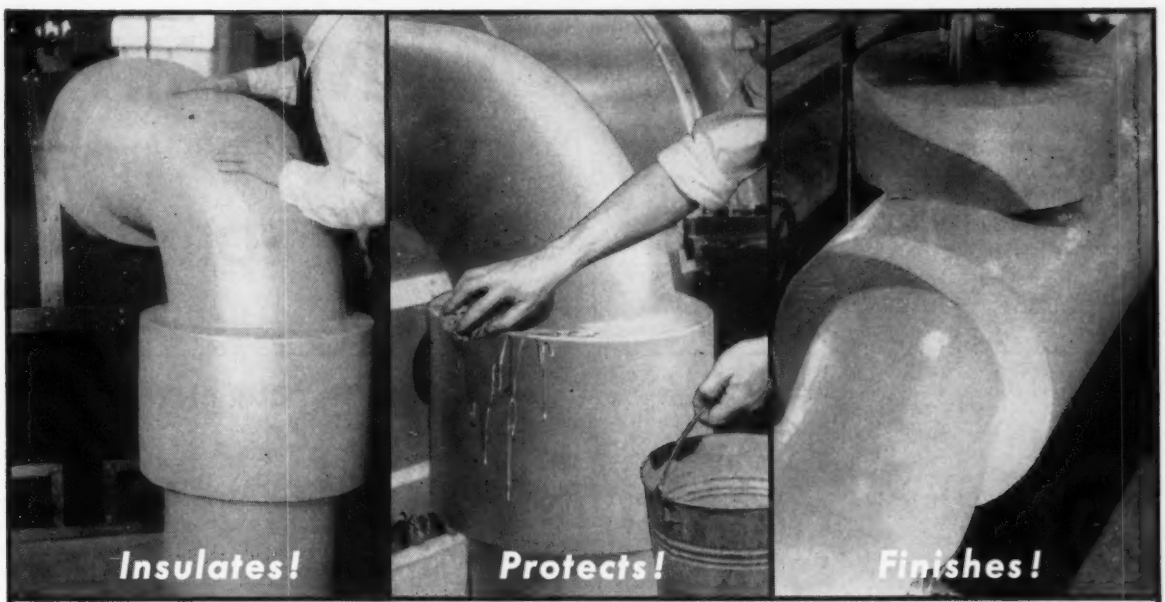
on ***Power's*** information-packed

SPECIAL REPORTS

"the most useful condensed handbooks in the power and plant service field."

1 QUICK APPLICATION INSULATES, PROTECTS, FINISHES!

EAGLE-PICHER
ONE-COTE CEMENT



- Saves time, work, money! One quick application provides smooth, light reflectant surface on hot or cold equipment!
- Clean, easy to handle! Just trowel it on—even on irregular areas where application of other insulations is often impractical.
- Highly efficient! Effective insulation at temperatures up to 1000 F.
- For outdoor installations! Quick-setting, withstands rain and moisture two hours after application. Prevents rust!
- For indoor installations! Requires no wire mesh or finishing treatment!

FREE SAMPLE!

Write today!

Prove to yourself, on your equipment, how Eagle-Picher One-Cote Cement can save you time, money and valuable man-hours.

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

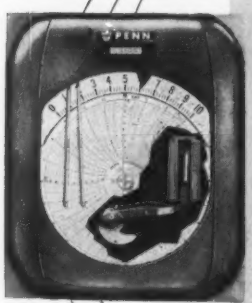
Since 1843

EAGLE EP PICHER

EAGLE-PICHER

The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

(*Member of Industrial Mineral Fiber Institute*)



Responds to Changes of one part in 2000 or less!

Burgess-Manning Electronic Flow Meters offer you this new high in sensitivity and speed of response for transmitting pressure differentials (for flow measurement), pressures, or actual motions. They are normally calibrated to 20% of maximum, but are available to 10% calibration of maximum flow on special order. Can be furnished with any combination (up to four) of flow, temperature and pressure pens. They feature extreme design simplicity and rugged construction, insuring a long dependable service life with minimum maintenance.

Write for Bulletin No. 1032

Send us an outline of your application for specific recommendation.

BURGESS-MANNING COMPANY
PENN INSTRUMENTS DIVISION
4114 Haverford Ave., Philadelphia 4, Pennsylvania

Instrumentation and Controls
for water, steam, gases, sewage and industrial wastes

Coming in September

* * *

Power's 75th ANNIVERSARY ISSUE

WATCH FOR IT!

Corrosion has an expensive appetite

PROTECT YOUR INVESTMENT WITH A *Harco* CATHODIC PROTECTION SYSTEM

If you can afford the bill . . . enjoy your guest. But remember . . . you've got this guest whether you can afford her or not. Check your profits . . . and see what this appetite is costing you regularly.

Electrolytic corrosion is the biggest single destroyer of buried or submerged metal structures and pipelines.

IT CAN BE STOPPED. That's where HARCO comes into the picture. It's our business to protect your investment. We are the specialists who can prevent and cure electrolytic corrosion . . . QUICKLY AND ECONOMICALLY. It is a fact . . . most cathodic protection systems pay for themselves in a matter of months . . . just through savings in normal maintenance and replacement costs.

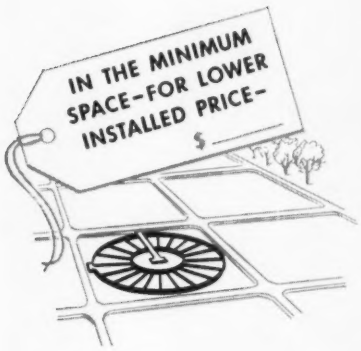
HARCO regularly supplies a complete range of services. Whatever your needs . . . engineered systems, contract installations or materials . . . LOOK TO HARCO . . . FIRST IN THE FIELD OF CATHODIC PROTECTION!

Write today for catalog or call MOntrose 2-2080

Harco

Cleveland • Albany • Atlanta • Chicago • Davenport • Detroit • Houston • Los Angeles • Louisville • Lynchburg • Minneapolis • New York • Oklahoma City • Pittsburgh • Philadelphia • Salt Lake City • Seattle • St. Louis • Toronto, Canada

CATHODIC PROTECTION DIVISION
THE HARCO CORPORATION
17049 Broadway • Cleveland, Ohio



You get high performance at low cost with INFILCO industrial water treating equipment

INFILCO

ACCELATOR®

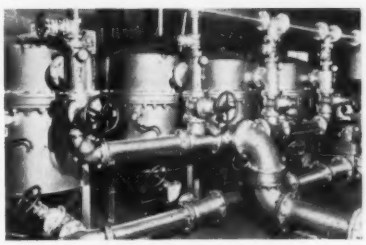
treatment plant saves up to 80%

of space required for separate mixing, coagulation and sedimentation basins in old style conventional treatment. Not a "sludge blanket," but a *single* basin high rate "slurry contact" unit with internal recirculation, for optimum clarification, softening or stabilization of liquids. **BULLETIN 1825**

ACCELATOR® HOT-FLOW®

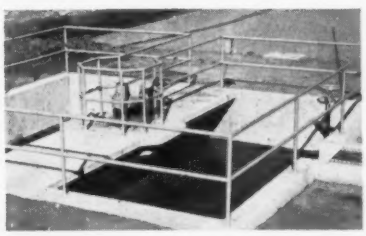
treating plants combine softening and deaeration in ONE unit

Specially designed for boiler feedwater treatment, using famous "ACCELATOR" plant principle for dynamic separation of water from slurry recirculated by steam lift. Maximum efficiency with minimum attention. **BULLETIN 1855**



STELLAR® FILTERS . . . the standard in diatomite filter performance

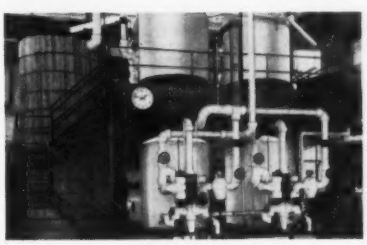
Especially applicable to industrial uses. Unique design and exclusive "air bump" cleaning feature facilitate long runs and short cleaning cycles. Compact, simple to service. **BULLETIN 1560**



VORTI® MIXERS

Efficient vortex flow pattern reduces power consumption

Provide rapid turbulent agitation by controlled multi-directional circulation. For round, square or rectangular basins. Simple trouble-free design, no underwater bearings. **BULLETIN 700**



CATEXER® ANEXER®

Ion Exchangers assure maximum regenerant efficiency, sustained capacity

For softening, dealkalizing, mixed bed and multibed applications. Simplicity of operation, high design standards guarantee longest useful life. Pressure or gravity types, any size. Specifically engineered to any industrial requirement. Manual, semi or fully automatic controls. **BULLETIN 1960**

INFILCO
INCORPORATED
General Offices • Tucson, Arizona • P.O. Box 5033
Field offices throughout the United States and in foreign countries

57401-P

INFILCO KNOWS HOW to help solve water treatment problems for industry and power

If you have any problems in the treatment of boilerfeed, process and potable waters for industry, INFILCO can help you.

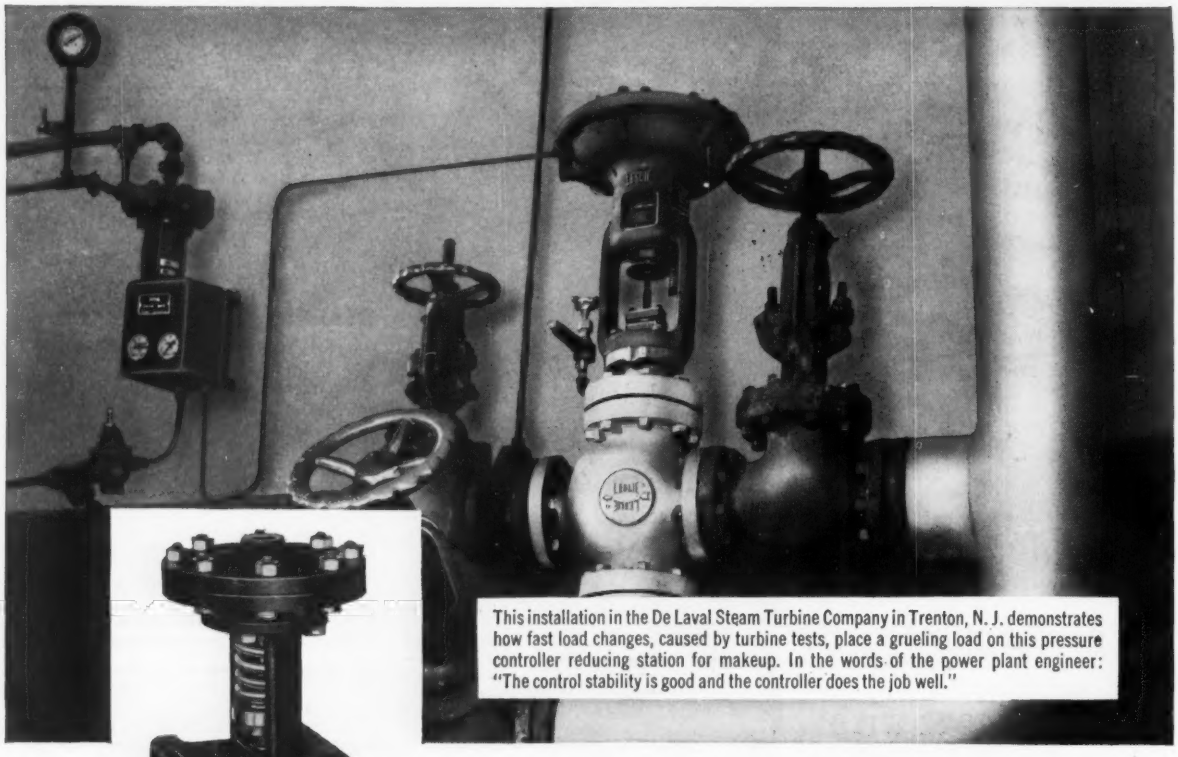
No other line of equipment is so complete – none so advanced in method and design. Above are only a few examples.

There is one best way to meet your needs. From broad and exhaustive experience extending over many years in this field, INFILCO engineers can give you the results you want at relatively low cost and highest efficiency.

It will pay you to investigate. Write today for bulletins of interest to you.

Inquiries and samples are invited on all problems in the treatment of waters, sewage and wastes for general industry, institutions and municipalities.

THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing – coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.



This installation in the De Laval Steam Turbine Company in Trenton, N. J. demonstrates how fast load changes, caused by turbine tests, place a grueling load on this pressure controller reducing station for makeup. In the words of the power plant engineer: "The control stability is good and the controller does the job well."

Leslie Pressure Pilot

Narrow Band Pressure Control *with Stability*

Wide band stability and narrow band proportional control are uniquely combined in the Leslie Control Pilot without need for extra mechanisms to correct for over-sensitivity.

While the pilot responds to small, *definite* pressure changes, it "sorts out" and "ignores" the small, spurious* disturbances common to most control systems. Since it does not follow nor magnify these disturbances, cycling and hunting are eliminated. It is ideal for systems with short lag factors.

*not directly related to process variables but resulting from pipeline friction and turbulence.

NO COSTLY EXTRAS

The "designed-in" stability and high capacity of Leslie Pressure Control Pilots also eliminates costly "extras" . . . there is no need for automatic reset, valve positioners or filter-type air sets. You get stable, reliable control *without* fussy adjustments and with *ordinary* plant air or water for the operating medium.

MORE INFORMATION

Ask your Leslie engineer to give you the complete story of the exclusive features that make Leslie Controllers ideal for straight pressure control problems. He's listed in your classified directory under "valves" or "regulators". Send for bulletin described at left.

Send for Bulletin 5303 that gives complete technical data and typical application sketches for the Leslie Pressure Control Pilot.

TRADE LESLIE MARK

REGULATORS AND CONTROLLERS

LESLIE CO., 235 GRANT AVENUE, LYNDHURST, NEW JERSEY

WHERE TO BUY

Featuring additional products specialties and services for power plants

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers — the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

POWER — Classified Advertising

STEEL PIPE & TUBING

• CHROME MOLY • CARBON MOLY
• CARBON STEEL • STAINLESS

Widest Range of Sizes & Specs in the U. S.
WRITE FOR STOCK LIST

MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

PROFESSIONAL SERVICES

CONSULTING DESIGN EXAMINATIONS PATENTS
CONSTRUCTION PLANS SURVEY • REPORTS TRADE MARKS

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction,
Investigations, Valuation and Rates
1500 Meadow Lane Pkwy, Kansas City 14, Missouri

THE LUMMUS COMPANY
Engineers and Constructors
385 Madison Ave., New York, N. Y.
Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

J. E. SIRRINE COMPANY
Engineers
Power Plant Consultations
Design Reports
Water Steam Utilization Plants
Greenville South Carolina

BURNS & McDONNELL
Engineers—Architects—Consultants
Kansas City, Mo. Phone
P. O. Box 7088 DElmar 3-4375

LUTZ AND MAY COMPANY
Consulting Engineers
Steam, Gas & Diesel Power Station
Pumping Plants—Electric Systems
Reports—Design—Appraisals
1009 Baltimore Kansas City 6, Mo.

STANLEY ENGINEERING COMPANY
Consulting Engineers
Hershey Building 208 S. LaSalle St.
Muscatine, Ia. Chicago 4, Ill.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Construction Supervision
Mechanical • Electrical • Structural
Sanitary • Chemical Laboratory
Business and Economic Research
New York Reading, Pa. Washington

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting Other Operations
231 So. La Salle St. Chicago 4

SWANSON, WRIGHT & CO. ENGINEERS LTD.
Consulting Engineers
Industrial and Process
Forest Products Industries
Power Plants
Reports, Specifications, Designs, Supervision
2210 West 12th Ave., Vancouver 9, B.C. CEdar 1154

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

SANDERSON & PORTER ENGINEERS
Construction
Reports *Surveys*
New York New York

TIPPETT & GEE CONSULTING ENGINEERS
Mechanical—Electrical—Thermodynamic—Structural
Design—Studies—Supervision
Power Stations—Transmission—Distribution
Industrial Plants—Process
1333 North Second Street Abilene, Texas

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical
1200 N. Broad St. Philadelphia 21, Pa.

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

WATER SERVICE LABORATORIES, INC.
Specialists in Water Treatment for Corrosion Prevention
Main Office:
423 W. 126 St. New York 27, N. Y.

PETER F. LOFTUS CORPORATION
Design and Consulting Engineers
Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural
First National Bank Building
Pittsburgh 22, Pennsylvania

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Mechanical—Electrical—Civil
Surveys Reports Design
101 Park Avenue New York 17, N. Y.

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant
Positions Wanted
Part Time Work

Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered

Employment Agencies
Employment Services
Labor Bureaus

DISPLAYED ——**RATES**—— **UNDISPLAYED**

The advertising rate is $25.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

$1.65 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers—counts as 1 line

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS or Inquiries to Classified Advertising Div. of Power, P. O. Box 12, New York 36, N. Y. for June issue closing May 7th.

PROJECT ENGINEERS

Plant Engineering Department of a large midwest research and development laboratory has several positions open for Project Engineers with a good academic background in Mechanical, Electrical, Chemical or Civil Engineering. Minimum of 5 years' experience required.

Responsibilities will involve coordinating the requirements, design, and construction of new buildings and facilities. Ability to provide close liaison between the research staff, architect-engineer, and construction contractor is necessary.

Write P-4816, POWER, 520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you c/o this publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Hospital Engineer. Glens Falls Hospital, Glens Falls, New York, 50 miles north of Albany on Hudson River foothills of Adirondack Mountains. 300 bed hospital. Require technical education and several years experience chief engineer of hospital. Fine American community and good labor market. Excellent area to raise family and wonderful outdoor recreation summer and winter. Salary open; will depend upon experience. William G. Illinger, Superintendent.

Combustion Engineer wanted by largest coal operator in its field for service to utilities, industries, commercial and domestic plants, and assistance in research. Attractive pension plan, hospitalization coverage, joint stock purchase program. In reply advise schooling, experience, expected starting salary, age, marital status. P-4588, Power.

Designers — Electrical — Piping — Struct. . . . Power Plants and Industrial Buildings, Marbarry Corp., 120 Greenwich St., New York City 6, N. Y. REctor 2-3749.

Mechanical Project Engineer for Power Plant Design. Must have college degree and 10 years experience on large Power Plant Design. Top Salary, Benefits, Permanent. All replies confidential. P-4754, Power.

Wanted for a 850 ton Sugar Factory in Eastern Uttar Pradesh (India) a highly qualified Chief Chemist and a Chief Engineer with at least 15 years practical experience of the actual working in factories. Persons with managerial experience and having research back ground will be preferred. Please apply with latest photograph and full particulars to: P-4704, Power.

SELLING OPPORTUNITIES OFFERED

Manufacturer's Representatives and Distributors —wanted to handle sales and service of miniature (¼ H.P. up to 5 H.P.) electric steam generators up to 100 lbs. pressure—each unit bearing a Registered National Board of Boiler and P. V. I. Number, individually inspected under the miniature boiler code. We have specialized in this field for 10 years and desire only men who know and work with steam, or equipment requiring steam for its operation. Please reply Box RW-3535, Power.

Water conditioning equipment manufacturer desires agents for New England and North and South Carolina area. RW-3789, Power.

BURNS AND ROE

invites

Mechanical • Electrical • Structural
Chemical and Nuclear Engineers . . .

to join their engineering staff for challenging and diversified assignments in and related to:

- **Steam Power**
- **Nuclear Power**
- **Hydro-Electric Power**

Positions open on several levels of responsibility. Excellent salary commensurate with experience and potential. If you are a U.S. Citizen and have experience in any of the above fields, forward a comprehensive resume in complete confidence to:

Personnel Department

BURNS and ROE, Inc.

Engineers and Constructors

160 West B'way, New York, N. Y.

POSITIONS WANTED

Division Superintendent in diesel-hydro system, now employed abroad, available July 15th. ICS diploma in electrical engineering; age 39. Prefer eastern U.S. PW-4346, Power.

Chief Engineer and/or Maintenance Foreman in steam power plant. Age 42, married, no children. Seven years operating experience (18 months in Peru) and 6 years in mechanical maintenance. Desire Latin American Position. PW-4791, Power.

Boiler room technician; Age 37. 17 years boiler room experience. Good references. PW-4908, Power.

Danish Electrical Engineer, graduated, age 33, desires career position, utility field, 9 years experience, Spanish speaking. PW-4834, Power.

Power Plant Superinendent, age 35, married, technical education, 12 years experience in all phases of operation and maintenance of turbo-electric power plants. PW-4733, Power.

SELLING OPPORTUNITY WANTED

Combustion engineer wants accounts for steam equipment Penna. greater Harrisburg-Reading-Coatesville-York area. RA-4901, Power.

FOR INFORMATION

About Classified Advertising

Contact
THE McGRAW-HILL OFFICE NEAREST YOU

ATLANTA, 3
1301 Rhodes-Haverty Bldg.
JAckson 3-6951
R. POWELL

BOSTON, 16
350 Park Square *HUbbard 2-7160*
H. J. SWEGER

CHICAGO, 11
520 No. Michigan Ave. *MOhawk 4-5800*
W. HIGGENS — J. BRENNAN

CINCINNATI, 37
1825 Yorktown Rd.
Swifton Village, Apt. 2 *REdwood 1-3238*
G. MILLER

CLEVELAND, 15
1510 Hanna Bldg. *SUperior 1-7000*
W. SULLIVAN

DALLAS, 2
Adolphus Tower Bldg., Main & Akard Sts. *RIverside 7-5117*
E. SCHIRMER—G. JONES

DETROIT, 26
856 Penobscot Bldg. *WOodward 2-1793*
W. STONE

LOS ANGELES, 17
1125 W. 6th St. *MAdison 6-9351*
H. L. KEELER — D. McMILLAN

NEW YORK, 36
330 West 42 St. *LOngacre 4-3000*
S. HENRY—D. COSTER—R. LAWLESS—R. HATHAWAY

PHILADELPHIA, 3
17th & Sansom St. *RIttenhouse 6-0670*
H. BOZARTH

ST. LOUIS, 8
3615 Olive St. *JEfferson 5-4867*
W. HIGGENS

SAN FRANCISCO, 4
68 Post St. *DOuglas 2-4600*
W. WOOLSTON

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED RATE:

$1.65 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS $1.65 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $17.90 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS or Inquiries to Classified Advertising Div. of Power, P. O. Box 12, N. Y. 36, N. Y. for June issue closing May 7th

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

LEFAX

TECHNICAL DATA BOOKS

POCKET SIZE • LOOSE LEAF

Loose leaf, 6 hole, 6¾"x3¾" bond paper, each book approx. 140 pages of technical data for student, engineer, technical worker. $1.40 ea.

Architecture	General Math	Phys. & Thermo.
Home Heating	Math Tables	Data
Illumination	Physics	Metals
Electrician's Data	Trig-Log Tables	Metallurgy
Builder's Data	Gen'l Chemistry	Hydraulics
Lumber Data	Chemical Tables	Radio
Air Conditioning	Analytic Chem.	Television & FM
Building Constr.	Mech'l Drawing	Electricity, AC
Reinf. Concrete	Machine Design	Electricity, DC
Piping Data	Machinist's Data	AC Motors & Gen'trs.
Surveying	Mech. of Materials	
Surveying Tables	Pwr. Trans. Mech.	Transformers,
Highway Eng'g.	Thermo. Tbls.	Relays & Meters

Write for FREE catalogs (2000 listings). Send $1.25 book or $6 for any five books to

LEFAX PUBLISHERS, Dept. PO-57, Phila. 7, Pa.

NEW STARTING AIR TANKS

1200 lbs. P.S.I. USCG Insp. 16"x83"

600 lbs. P.S.I. Navy Insp. 17"x73"

ALJON ELEC. DIESEL CO.

904 Pacific St., Bklyn. St. 3-6515

2 ENGINES—WOOD HULL

400 (at 300) ATLAS Imperial ENGINE 13 x 16, 2000 hours—complete in good order—with extra parts reasonable. MURPHY DIESEL 96 H.P. (NEW), 4 cyl. 5⅝ x 6½ full load RPM 1200, price less than half list. Excellent HULL reg. 91 x 21 x 10.7., 145 tons completely equipped throughout dragger, except main engine. Price 1/3 replacement.
SLADE, 75 Central St., Boston 9, Liberty 2-4366

WANTED FOR EXPORT

Unused Turbo-Generators 1000 KW—2500 KW—5000 KW with or without Boilers.

Can be Government Surplus or standby equipment up to 20 years old.

Also wanted—new or used Diesel and Turbo-Electric Generators and complete Power Plants.

MACHINERY EXPEDITERS

Our 16th Year

170 Broadway, New York 38, N.Y.

3 NEW BOILERS

Available at fraction of new cost

BABCOCK & WILCOX single uptake controlled superheat marine type express boilers, 3 drums, with economizers.

Designed pressure	634 lbs.	Steam temperature	850°F
Operating pressure	550 lbs.	Furnace volume	1473 cu. ft.
Superheated steam	221,000 lbs./hr.	Total generating surface	9338 sq. ft.
Saturated steam	32,000 lbs./hr.	Superheater surface	1620 sq. ft.
Full power total	253,000 lbs./hr.	Economizer surface	3843 sq. ft.

NOTE: These boilers are new and complete. They are erected and ready for use and should therefore be considered only for such places as can be reached by water transportation.

HUGO NEU CORPORATION

45 Nassau St. Tel.: REctor 2-1334 New York 5, N. Y.

WANTED

COMPLETE STEAM POWER PLANT

Including Turbine Generator sets—BOILERS—CONDENSERS. Coal handling equipment and all power house accessories.

Approximately 10,000 KW total capacity, consisting preferably of three units.

3/60/2300 or 4160 or higher.

Will consider any steam pressure 200 pounds or higher.

For installation in Canada

SOUL CLINIC, INC.

CALGARY, ALBERTA, CANADA

WANTED

Complete power plants, turbo generators, Boilers, Condensers, Engine generators, Processing Plants and equipment.

PAUL OBERMAN

1910 Delmar St. Louis, Mo.

WANTED

Complete Power Plants • MG Sets

Turbo-Generators

We are particularly interested in 25 cycle power equipment.

THE KAISER-NELSON COMPANY

6272 Canal Road Cleveland 25, Ohio

WANTED

300 HP USED MOTOR

900 R.P.M. 220 volts 60 cycles, 3 phase squirrel cage or slip ring, with starting controls, automatic or manual with low voltage starting.

W-4660, POWER

Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

CASH FOR SURPLUS NEW MOTORS

Ajax pays hard cash for your new surplus motors, controls and transformers. Send your list of new surplus equipment today. It means cash for you.

NEW MOTORS AVAILABLE

We have over 5,000 new motors—IN STOCK—from ¼ HP to 200 HP. Save Money.

Write, wire or phone collect!

AJAX ELECTRIC MOTOR CORP.

P.O. Box 262 • Rochester, N.Y.

Long Distance Phone LD. 132

BELYEA RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT
SELECTED STOCK ITEMS
RE-NU-BILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES —
D.C. MOTORS WITH M.G. SETS & CONTROLS
PACKAGE DRIVES IN STOCK

1—1200 HP G.E. MPC, 600 V. D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 HP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

1—850 HP, G.E., Type MCF, 250 volt DC, 800/1200 RPM, and 675 KW, M-G Set, DC Gen., G.E., Type MCF, 250 volt, DC, with 1160 HP, .7 PF, G.E. Synch. Motor, Type ATI, 2300/4600 volt, 900 RPM, 3 phase, 60 cycle.
Above with variable voltage control.

1—800 HP, Westinghouse Mill Motor, 500 volt DC, 250/550 RPM. Coupled to

1—800 HP United Gear Reducer ration 7.04:1 with 750 KW G.E. M.G. Set, 300 V. D.C. with 1400 KVA Motor 13200/6600 V.
With magnetic DC Control.

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
2	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6900	1187
1	1100	F.M.BB	SF806S	4800/2400	1800
1	800	G.E.	MT	2200	293
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	400	Whse.	CW	440	514
1	350	Cr. Wh.	SIZE-718R	208/406	1765
1	350	G.E.	IM-17A	440/3200	720
1	250	Cr. Wh.	MT-424Y	4000	257
1	250	G.E.	SIZE-290	2300	350
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
1	200	G.E.	MT-557Y	2200	1760
1	150	Whse.	CW30517	2300	435
1	125	A.C.	ANT	440	865

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	650	G.E.	FT-559BY	440	3570
4	500	Whse.	CS-1216	2200	500
2	450	Whse.	CS-1420	2300/4150	354
1	400	G.E.	1K	2200	580
1	300	G.E.	KT-559A	2300	1775
1	200	G.E.	1K-17	440	580
2	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900
1	2000	Whse.		2300	120
2	250	G.E.	TS	2300	150

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
2	2100	G.E.	514	250/300	2300/4600
1	2000	G.E.	500-25cy	660	11000
2	2000	G.E.	514	250/300	4600/2300
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1000	G.E.	900	260	6600
3	1000	G.E.	720	600	6800/13200
1	750	G.E.	720	275	6800/13200
2	1000	G.E.	514	600	6600/13200
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
2	300	G.E.	1200	250	2300
2	300	Whse.		600	2300
1	200	Whse.		550	2300
1	150	Whse.	1200	275	2300

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
1	3000	G.E.	OISC	3	33000x2300
1	1500	G.E.	PYRANOL	3 auto	4000/4200/4400
2	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x85/55
1	833	G.E.	OISC	1	13800x460
2	500	KUHL	OISC	1	13800x6900
3	333	G.E.	OISC	1	13200x2300
3	250	L.M.	OISC	1	14400/13800x240/120

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E.	60/50/40	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/52.5	4400/2300
1	500	Al. Ch.	25/60	11000/2300
1	300	G.E.	60/3000	440/300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	10000	Whse.	Condensing 650 lbs. 750° F.T.T. Surface Condenser Dir. Conn. Exciter.
1	5000		Auto Extraction Condensing 650 lbs. 750° F.T.T. Auto.
1	1000	Moore	Auto.-Ext. Cond. 175300# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/3300. Non-condensing 175/300 lbs. I.S.P. 5/20 lbs. G.B.P., 450/3/60.

BELYEA COMPANY, INC.

49 Howell St., Jersey City 6, N. J.

Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	750	G.E.	H	1	4600-120/240
1	750	G.E.	HT	3	4150Y-220/440
2	250	G.E.	H Pyranol	1	2400-4800-3320Y-120/240
2	250	West.		1	2300/4600-230/460
3	200	West.	S	1	2400/4160-240/480
3	200	G.E.	H-KD	1	13800/12420/4600-240/480
3	200	G.E.	H	1	7800/15600-220/440
1	150	Eisler	OA	1	4160-240/480
3	50	G.E.	H Form K	1	2400/4160-240/480
3	50	Niagara	Air Cld	1	2300-120/240
2	37½	West.	Hypersil	1	2400/4160-240/480
4	25	West.	Hiperiol	1	2400/4160-120/240
3	15	West.	H Pyranol	1	6900/11950Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	E.M.	900		4800
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	360		2200
1	150	West.	900		220
1	300	E.M.	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	360	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AV	220
1	75	G.E.	600	IM	440
3	150	Allis-Ch.	1800	AY RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	25	G.E.	1170	405TEFC	220/440
1	40	Wagner	1750	CP-444 TEFC B.B.	440
1	75	West.	1180	CS-607	440
1	100	G. E.	1775	KTP-543	440
1	100	West.	1160	CS	440
1	150	G.E.	720	KT-562	440
2	250	G.E.	1790	K.T.E.F.C.	2300
1	275	G.E.	1200	KT559BS	2200
2	300	G.E.	1800	K-4150V	new
1	400	Cont.	1200	N806S	2300

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	AC
1	30	G.E.	1800	125	220/440 V.
3	60	E.M.	1200	125	220 v. Syn.
1	150	Cr. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.B.
1	1000	West.	720	600	2300/4160Y

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	75	C.W.	900	WP
1	125	G.E.	1790	RC
2	150	C.W.	900	WP
1	250	Allis Ch.	1750	FBL149BB

A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	35	G.E.	MTC	565	440
2	300	G.E.	ITC-5017	600	440

"FOR POWER"
J.L. HEMPHILL & CO.
1020 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 7

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—3000 KW—2400/4160—400# Ext. 175# & 5#. New 1947

1—2000 KW—2400 volts—400# new 1940. Rebuilt 1947

1—1000 KW—240 volts—130/250# Condensing Auto. Extraction—15#—New 1945

1—1000 KW 480 volts—225# Condensing Auto. Extraction—20#

1— 400 KW—550 volts—400# Condensing Auto. Extraction—20/50# New 1948

1— 300 KW—480 volts—210# Condensing Auto. Extraction—40#

1— 250 KW—240 volts—130#—Non-Cond. 10/12# Back pressure

TRANSFORMERS

1—500 KVA 4160/480 V. Pyranol. 3 ph.
3—500 KVA 2300/550 Volts (New 1948)

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

DIESEL ENGINES

2000 Hp Alco, 16 cylinder, supercharged
2000 Hp Fairbanks Morse 10 cylinder OP
1600 Hp Fairbanks Morse, 9 cylinder OP
1500 HP Baldwin-Lima, 8 cylinder, supercharged
1050 Hp Baldwin-Lima, 8 cylinder, supercharged
LATE TYPE—PRICED RIGHT

ALJON ELEC. DIESEL CO.
904 Pacific St., Brooklyn, N. Y.

HYDRO ELECTRIC GENERATING UNIT

Vertical type—585 HP—36 Ft. Hd.—150 CSF. Westinghouse Generator—500 KVA—2300 Volt —Direct Connected Exciter—Woodward Governor—Complete Switchboard—Leffel-F-Turbine. Location—Washington D.C. Reasonably Priced.

SORENSEN GOVERNOR SERVICE
264 Kossuth St, Bridgeport 8, Conn.

1875 KVA NON-CONDENSING ELLIOTT TURBINE GENERATOR

400 PSIG, 750° FTT (with changes), was operated at 250 PSIG, 35/75 PSI Back Pressure, 600° FTT, 197.4° FSH. Generator, 1875 KVA, 1500 KW, 80% PF, 3/60/480, Direct - connected Exciter, Switchboard. Complete Set in exceptionally good condition. New in 1946.

Immediate Delivery

Full information furnished on request

DELL STEPHENSON & COMPANY
14456 Glastonbury, Detroit 23, Mich.
Phone: Vermont 5-0697

Save on Your INDUSTRIAL TRACK

FOSTER *QUALITY* — FULLY GUARANTEED

RELAYING RAILS

Handle more cars better—cost less to install and maintain. Foster stocks all Rail Sections 12# thru 175#, Switch Material and Track Accessories.

SEND FOR CATALOGS

RAILS - TRACK EQUIPMENT - PIPE - PILING
L.B. FOSTER CO.
PITTSBURGH 30 • NEW YORK 7 • CHICAGO 4
ATLANTA 8 • HOUSTON 2 • LOS ANGELES 5

3125 KVA AUTOMATIC EXTRACTION-CONDENSING

The above Worthington-Cracker Wheeler Turbine-Generator is a modern unit. Turbine #5211, 250/300 PSIG, 750°FTT (good for 400# with changes) controlled extraction 15 to 50#, 30,000#/hr., 80% throttle flow extraction. Cracker-Wheeler Generator #892503, 3/60/13,800 V. with shaft-driven Exciter, Surface Condenser with all auxiliaries.

CHARLES WEAVER

19701 James Couzens Hwy. Tel: BRoadway 3-1901 Detroit 35, Michigan

FOR SALE

A.C. & D.C. DIESEL GENERATOR SETS

D.C. SETS

1200 KW G.M. 16-278A. ENGINE: 1600 HP @ 720 RPM—serial #11977—model GM 16-278A. GENERATOR: 1200 KW—525 volts—3000 amps @ 720 RPM. Totally enclosed—water-cooled—mfg. by Allis-Chalmers. All engine operating accessories—filters, strainers, pyrometers, gauge board, etc. Generator control is available.

300 KW Baldwin (2 available). 120/240 volts DC Baldwin-De La Vergne model V-O. ENGINES: 448 HP — 400 RPM—6 cyl. — 12¾" bore — 15½" stroke. GENERATORS: Westinghouse 300 KW—120/240 volts DC—1250 amps.—400 RPM—40°C—7.02 shunt field amps. ACCESSORIES: Lube oil coolers; water jacket coolers; exhaust muffler; vibration isolators; commercial filter; edge-wound Purolator strainers. DIMENSIONS: 222" long—76" wide—103" high.

450 KW G.M. 12-567. ENGINE: Made by Electro-Motive Div. G.M.—model 12-567—12 cyl. GENERATOR: Made by G.E.—450 KW—230 volts DC—1800 amps—with 10 KW top-mounted exciter.

A.C. SETS

1250 KVA GM 16-567. ENGINE: 16 cyl. model GM 16-567—mfg. by Electro-Motive Div. GM. GENERATOR: Westinghouse 1250 KVA—4600/2300 volts—3 phase—60 cycle—80% P.F.—720 RPM—synchronous. (Can be rewound for 440 volts) S.O. 6P455—serial #1SP455. Complete with 10 KW direct connected exciter. Included is circuit breaker, 15000 volt oil draw-out type, by Westinghouse, type F-124—600 amps—60 cycle—solenoid operated. Spare parts included factory reconditioned blower; extra blower; new heads; liners; pistons; valves, etc.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
Baltimore 2, Md.—Lexington 9-1900

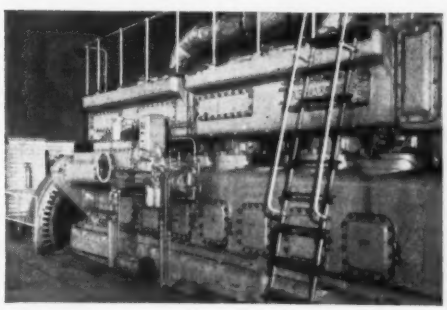
BOILERS

HI-PRESSURE
Complete stock from 10-2,000 hp.p
Nation's largest inventory. New & Used.
WABASH POWER EQUIPMENT
31 E. CONGRESS, CHICAGO 5, HA 7-4855

426 HP 180# Press. B&W WT Boilers
24" & 42" & 48" Belt Conveyors
40-150-600 HP Package Type Boilers
40-125-175 HP Scotch Marine Boilers
15 & 25 Ton Diesel Locomotive Cranes
14x42"—16x36"—18x42" Corliss Engines
400 HP 160 & 300# Sect. Hdr. Boilers
H. & P., 6719 Etzel, St. Louis 14, Mo.

MODERN SLOW SPEED
DIESEL ELECTRIC GENERATING SET
OFFERED AT CONSIDERABLE SAVING

ALSO AVAILABLE
•
WORTHINGTON
BB5
100 KW
600 RPM
3/60/480
•
Other Sets from 20 KW to 1200 KW



COMPLETE WITH ALL AUXILIARIES
—
Other Sets from 20 KW to 1200 KW

FAIRBANKS MORSE MODEL 33F16
1125 KW 300 RPM 3/60/480V

NATIONAL METAL & STEEL CORP.
1251 NEW DOCK STREET, TERMINAL ISLAND (LOS ANGELES HARBOR), CALIF.
CALL LOS ANGELES NE-dio 6-9871
DIESEL DIVISION

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2200	Whse.	600
500	4000/2300	G.E.	900
450	440	Whse.	514
400(2)	2300	G.E.	900
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3450
250	2200/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	440/220	Whse.	720
150	2200/440	G.E.	600
125	2200	G.E.	720
100	440/220	G.E.	720

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
150	440/220	G.E.	TS	720
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2300	G.E.	FT	3600
500	2300/4000	Elliott	SC	1800
350	2300	G.E.	IM	600
350	440	G.E.	KT	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
250	440/220	G.E.	KT	720
250	2300	Whse.	CS	600
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	440/220	G.E.	KT	720
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200

A. C. GENERATORS

1—320 kva, 686 rpm 2300/440/220 V., G.E.
1—360 kva, 900 rpm, 2300 V., Whse.
1—225 kva, 60 rpm, 220/440 V., G.E.
1—187 kva., 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
3—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V, G.E.
1—400 Amp., Condit, 3P, 25 KV outdoor
1—400 Amp., R. Smith, 3P 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	850

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
150	Whse.	440/220	Sq. Ca.	275
125	G.E.	4000/440	Syn.	125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1—600 kva, Standard, 13,800—2300 V., 3 ph.
3—500 kva, G.E., 13,800—2300 V.
3—333 kva, G.E., 13,800—2300 V.
3—333 kva, G.E., 2400—480 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3—200 kva, G.E., 2400—120/240 V.
3—200 kva, Mol., 13,800—2300 V.
3—150 kva, Al. Ch. 2400—230 V.
2—150 kva, Al. Ch., 440-220 V., dry, New
3—100 kva, G.E., 2400—240/480, V New
3— 75 kva, Whse., 2400—240/480 V.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

MODERN POWER PLANT

1875 KVA WORTHINGTON MOORE TURBINE 400 PSI, 700°F, Condensing, driving 2300 Volt CROCKER WHEELER GENERATOR 25000#/Hr, 450 PSI, 738°F, Coal Fired BOILER; includes all auxiliaries, controls, 25 Ton powerhouse crane and coal handling facilities.

WIRE — PHONE — WRITE

HEAT & POWER CO., INC.
60 E. 42nd St., New York 17, N. Y.
Murray Hill 7-5280
(Machinery & Equipment Merchants)

FOR SALE

HEAT EXCHANGERS
FEED WATER HEATER

206 sq. ft. Surface—6 Water Pass

Working pressure: Shell 10 lbs., tubes 575 lbs. p.s.i.—Tubes: 210 ea. ⅝" O.D. .065" Gauge, 6'4" Long—Manufacturer: Struthers Wells—Shipping Weight: appr. 2300 lbs. O.A. appr. 26" dia. x 8'.

HUGO NEU CORPORATION
45 Nassau Street, New York 5, N.Y.
Tel. RE 2-1334

-TRANSFORMERS-

BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.
5318 Hetzel St. Cincinnati 27, Ohio
45 Years' Dependable Service

TRANSFORMERS

2—2000 Kva GE 13200-2400 Scott Tap
3—1667 Kva GE 13800-600
3—1000 Kva GE 13800-460
15— 50 Kva GE 33000-2400 New
120— 25 Kva GE 33000-2400 New

MOTORS • GENERATORS
TRANSFORMERS • SALES
REPAIRS • RENTALS

AMERICAN ELECTRIC SERVICE & MAINTENANCE CO.
Paramount & 2nd Sts., Springfield, Mass.
REpublic 2-2104; 2-2105

FOR SALE

Babcock and Wilcox package Type F-9 #57 integral furnace boiler designed for 250# pressure, 25,000 pounds per hour steaming capacity at continuous operation at 200# P.S.I. with 457 degree F. at superheater outlets.

Automatic control with complete complement of meters, gauges, recording instruments, etc. Operation on either oil or gas fuels.

W. R. SPRAGUE
Director of Purchases

AMERICAN HOIST & DERRICK COMPANY
63 S. Robert St., St. Paul 7, Minn.

DIESEL GENERATOR SETS

2—McIntosh-Seymour (Alco) 950 HP 8 cyl. 225 RPM, 875 KVA Westinghouse 3 phase, 25 or 60 cycle alternators. 20 KW exciters.

1—McIntosh-Seymour (Alco) 600 HP 5 cyl. 225 RPM, 500 KVA General Electric 3 phase, 25 or 60 cycle alternator. 15 KW exciter.

Complete plant installation with all accessories. Priced attractively. With or without generators.

WHISLER EQUIPMENT CO.
611 Olive St. • St. Louis 1, Mo.

FOR SALE

SKINNER-ENGINE and 250 KW GENERATOR

CURRENT—440—3 P 60 Cy.
WITH CONTROLS

REASON FOR SELLING TO SMALL

WAHLFELD MFG. CO.
PEORIA — ILLINOIS

FOR SALE

500, 1000, 3000, 3500 & 7500 KW Turbo-Generators. 25,000 35,000 75,000 & 2—90,000 LB/HR Water Tube Boilers. Misc. Items of Steam-Elec. Plant Equip. Contact J. P. CRAWFORD, Supt., City Water & Elec. Dept., Dyersburg, Tennessee.

SPECIAL
ELECTRIC DOUBLEDRUM MINE HOIST
FOR SALE

400 H.P. 2300/3/60 Each drum 84" diam—54" face—900 ft. per min—20,000 pounds rope pull — one drum clutched — hydraulic brakes — Lilly control — Excellent condition —still in use in Canada—Available shortly.

SOUL CLINIC INC.
Calgary, Alberta, Canada

Complete Power Plant & Auxiliaries

2—1500 KW Turbo-generators—1 New 1948
1000 KW Turbo-generator unit
B&W Boiler, 45000#/hr @ 450#—New 1951
B&W Boiler, 27500#/hr @ 450#—New 1948
Springfield Boiler, 348 hp @ 300#
Sterling Boiler, 362 hp @ 150#

Other Equipment for Sale

500 KW Turbo-generator & auxiliaries
B&W Boiler, 35000#/hr @ 160#
Fairbanks-Morse Diesel, 840 hp, 700 KVA
Rathburn-Jones Diesel, 1800 hp, 1250 KW

Transformers Wanted

1500 KVA capacity, 69000-7200/12470 Y
3000 KVA capacity, 69000-2400/4160 Y
5000 KVA capacity, 69000-2400/4160Y

CONTINENTAL CORPORATION
790 Fulton St. Denver 8, Colorado

STEAM POWER PLANT FOR SALE

25,000 Horsepower Steam Power Plant including Steel Frame Building with wooden walls, Travelling Crane over Turbine Room; One Stirling-Type Boiler with Harrington Chain Grate Stoker, capacity 38000 lb. per hr. at 200 p.s.i.g. and 120 deg. superheat, with Clinker Chills, forced and induced draft fans; One VU-Type Combustion Engineering 80,000 lb. per hr. Boiler at 400 lb. p.s.i.g., with superheater, air preheater, forced and induced draft fans, steel Smokestack and Raymond Impact type Coal Pulverizers; One VU-Type Combustion Engineering 80,000 lb. per hr. Boiler at 250 p.s.i.g., with superheater, air preheater forced and induced draft fans. Steel Smokestack and Raymond Bowl Mill type Coal Pulverizers; One Pneumatic Ash Handling System; Coal Handling System including Bunkers above Boilers; One 500 K.W. 480 Volt, 3-phase Turbine with Jet Condenser; One 2,000 K. W., 6600 Volt, 3-phase Turbine with surface Condenser; One 5,000 K.W., 4600 Volt, 3-phase Turbine with surface Condenser and enclosed Generator Cooling System; One 10,000 K.W., 13,800 Volt, 3-phase Turbine with surface Condenser and enclosed Generator Cooling System; all for 60 Cycles; Circulating and Service Pumps; Exciters and Switchboard including 15,000 Volt outdoor-type Cubicles and Steel Step-up Structure.

All of the above in operable condition and inspectable in use. Being offered for sale in present location for shipment shortly after April 15th, 1957.

For any additional information, Apply to THE GRANBY CONSOLIDATED, MINING SMELTING & POWER CO. LTD., 1111 West Georgia Street, Vancouver, B. C. (or) THE GRANBY CONSOLIDATED, MINING SMELTING & POWER CO. LTD., Copper Mountain, B. C.

NEW STEAM JET AIR EVACTORS

Several in stock, large range in sizes, capacities from 1000 KW to 10,000 KW. Priced right.

CHARLES WEAVER
19701 James Couzens Hwy.
Detroit 35, Michigan
Phone: BRoadway 3-1901

WORLD'S LARGEST INVENTORY

NEW AND GUARANTEED REBUILT EQUIPMENT

WRITE, WIRE OR PHONE

ELECTRIC EQUIPMENT CO.
L. D. (Long Distance) 65
ROCHESTER 1, NEW YORK

GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

SLIP RING MOTORS

3 Phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	Make	Type	Speed
2500	*G.E.	MT	257
1200	*Al-Ch.	ANT	1800
600	*G.E.	MT	450
500	G.E.	M-6345	1200
300	G.E.	IM-17B	600
250	*G.E.	IM	720
200	G.E.	IM	800
200	Westg. (2)	CW	514
200	*Westg.	CW-905-A	514
150	Cr.-Wh.	50-R	1800
150	Westg.	CW	450
125	G.E. (2)	IM-15A	600
100	G.E.	IM-13A	1800
100	G.E.	MTC-5548	900
100	G.E.	IM	720
100	G.E.	IM	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al-Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al-Ch.	ANY-26F	900
75	Al-Ch.	ARY	720
75	G.E.	MT-352	720
75	G.E.	MT-556	720
75	G.E.	IM	600
60	Al-Ch.	ARY	1200
60	G.E.	MT-546	1200
60	*G.E.	MT-536	1200
60	*Westg.	CW-762C	900
50	Westg.	CW	1800
50	G.E.	IM-11A	1800
50	*Al-Ch.	ARY	1200
50	Westg.	CW-636A	1200
50	*G.E.	MT-538	1200
50	Westg.	CW-658-A	900
50	G.E.	MT-338	900
50	G.E.	MT-346	720
50	Al-Ch.	ANY-26F	600
50	G.E.	IM	450
40	G.E.	MT-532	1200
40	*G.E.	MT-338	900

SLIP RING MOTORS

Crane & Hoist Service
3 Phase, 60 Cycle, 220 or 440 Volt

HP	Make	Type	Speed
80	G.E.	MTC-5552	600
75	Westg.	CI-756-A	600
50	Westg.	MW-334	600
50	G.E.	HICTENV	600
35	G.E.	MTC-5536	600
20	Westg.	CI	1200
11	Westg.	CI-E464	900
10	P & H	BW-6	1800
5	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-5944	900

SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

HP	Make	Type	P.F.	Speed
1400	Westg.	HG	.7	900
400	Westg.	HG	1.0	900
300	G.E.	ATI	.8	720
300	*Ideal	SMM	.8	257
275	*G.E. (2)	ATI	1.0	450
250	Al.-Ch.	SYN	1.0	1200
225	G.E.	TS-6244	1.0	300
225	Elec. Mchy.		1.0	360
190	Elec. Mchy.		1.0	720
150	Al-Ch. (2)	SYN	.8	1200
150	Fair.-Mor	TJC-285	.8	720
150	*Elec. Mchy.		.8	1200
150	Westg.	HR	1.0	300
125	*G.E.	TS-7641	1.0	514
125	*G.E.	TS-8214	1.0	327
125	*Elec. Mchy.		1.0	900
115	Elec. Mchy.		1.0	240

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

HP	Make	Type	Speed
1250	*Al-Ch. (3)	ANX	3600
1200	*Al-Ch.	ARW	1200
750	*Westg.	CS	900
500	*Al-Ch.	ARW	3500
500	Gen. Elec.	K-6345	1200
500	G.E.	KT-424	450
350	*G.E.	KT-559A	1800
250	West	CS-8120S TEFC	1800
250	G.E. (2)	KT-550	1800
250	*L-Allis	8EX-143	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
200	*G.E.	FT-549Y	3600
200	*G.E.	IK-13B	1800
200	G.E.	IK-16	1200
200	*Al-Ch.	ANZ-TEFC	900
200	*Westg.	CS-930A	900
200	G.E. (2)	KF-5848	720
200	*Al-Ch.	AN	720
200	Westg.	CS-1010	600
200	Al-Ch.	ARWWT	600
150	Cr. Wh.	SC-149 Vent	3450
150	G.E.	IE-13B	1200
150	*Al.Ch.	AN-30F	1200
150	G.E.	IK-15A	900
150	*Westg.	CS	600
125	*Westg.	CS-771 Sppf.	1800
125	*Al-Ch.	AR	1800
125	Westg. (2)	CS-761S	1750
125	Cr-Wh. (2)	Size SQR	1200
125	G.E.	K-558	900
125	Al-Ch.	AN	514
100	Westg. CS	5075 TEFC	3600
100	*Westg.	CS-760A	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FTRP-543	1800
100	Al-Ch.	ARZ-826FS	1200
100	*Westg.	CS-760D	1200
100	G.E.	KT-553	1200
100	Al-Ch.	AW-23D86	1200
100	*G.E.	KF-556	900
75	G.E. (2)	FT-529Y	3600
75	Al-Ch. (3)	AR-445S	3600
75	G.E.	KG-445	1800
75	G.E.	KT-537	1800
75	*Al-Ch.	AR505S	1765
75	G.E.	KT-546S	1200
75	*G.E.	KF-542	1200
75	Westg.	CS-6642	1200
75	Al-Ch.	APZ-505	1200
75	G.E.	KT-342	1200

MOTORS DIRECT CURRENT

H.P.	Make	Type	Speed
250	Westg.	SK-220	450/600
200	Rel. (2)	1400T	850/1200
200	Westg.	SK-201	850
200	Cr.-Wh.	CM	500
175	G.E.	ETC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
100/150	G.E.	MCF	380/1000
50	Cr.-Wh.	CMC	700/1100
35	West (2)	SK-150	350/1000
30	Cr.W.	CCM-504	450
30/40	G.E. (2)	CD-123	400/1800
30/40	G.E.	CD-115	500/1500
25/30	G.E. (2)	RF-12	500/1500
25	G.E.	RC-32	800
25	Westg.	SK-133	575
20/25	Westg.	SK-151L	250/1000
20	Star	SB-10	1750
15	Westg.	SK-103	400/1600
10/15	Reliance	185T	400/1600
10/15	Westg.	SK-121	250/1000

MOTOR-GENERATOR SETS

KW	Make	A.C.	D.C.
1250	Westg.	6600/4180	600
1000	G.E.	12000	600
500	G.E.	4160/2300	250
400	A.C.	2300	120/240
300	G.E.	440	250
250	G.E.	440	250
200	G.E.	2300	250/275
200	Westg.	2300/4000	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.C.	2300	275
150	Westg.	2300	125/250
150	G.E.	440	275
125	Cr-Wh. (3)	4160	125
100	G.E.	2300	250
100	Al-Ch.	2300	250
100	Elec.-Mach.	440	125
100	G.E.	440	125
90	G.E.	220/440	125
75	G.E.	440	125
50	Reliance	440	250
50	Ideal	2300	250
50	Westg.	220/440	250
50	Westg.	240	125
50	G.E.	440	125
40	G.E.	440	125
25	Westg.	220	275
20	G.E.	440	250
20	Bague-G.E.	440	125
20	G.E.	220/440	250
15	Westg.	220/440	250
15	Ideal	440	125

DYNAMOMETERS

HP	Make	Type	Speed
125	G.E. Cr.	TLC-20	2700/6000
150	G.E. 3 Cr.	TLC-50	2500/5000
200	Westg.-Bk.	SK-151	1350/4000

PLATERS

AMP	MAKE	VOLTS
7500/3750	Elec. Prod.	6/12-220/440
7500/3750	Chandy.	12/24-220/440
6000/3000	Chandy.	12/24-220/440
2000/1000	Chandy.	6/12-220/440
1500/750	Chandy.	12/24-220/440
1500/750	Chandy.	6/12-220/440
1000/500	Chandy.	12/24-220/440

TRANSFORMERS

KVA	MAKE	TYPE	VOLT
1000	G.E. (3)	Oil	13200-2300
1000	Wagner (3)	Oil	13800-240/480
833	G.E. (3)	Oil	13800-480
667	Al. Ch. (3)	Oil	34500-2400/4160Y
677	G.E. new (1)	Oil	33000-480
500	G.E. (3)	Oil	13800-480/230
333	Al-Ch. (3)	Oil	13200-2400
250	Westg. (3)	Oil	2400/4160-480/240
150	Chg. El. (3)	Air	2300-110/220
100	Al. Ch. (3)	Oil	2400-240/480
100	Jeff. (3)	Air	2400-220/110
100	Maloney (2)	Oil	2300-220/110
100	G.E. (2)	Oil	2300-115
100	G.E. (1)	Oil	2400-120/240
100	Pitts. (3)	Oil	2400-575
100	Pitts. (1)	Oil	2400-120/240
75	G.E. (3)	Oil	2400-120/208
50	West. (3)	Oil	7200/12470-120/240
50	West. (2)	Oil	2300/1150-115

First Source for 47 Years for Quality Electrical Equipment

CHICAGO *Electric Co.*

1320 W. CERMAK RD. CAnal 6-2900 CHICAGO 8, ILL.

A.C. 20 KW DIESEL GEN. SETS

New & Test Run Only

120/208 volt 3-phase 60 cycle 1800 RPM—with voltage regulators on generators and direct connected exciters. DIESEL ENGINE: Sheppard Model 6D—4½x5—3 cyl.—radiator cooled—212.8 cu. inch displacement. Built 1953 and in current production. Spare parts available.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
Baltimore 2, Md.—Lexington 9-1900

FOR SALE

5—OIL CIRCUIT BREAKERS

Whse. late type, outdoor type, De-Ion Grid, T.P.S.T., Rated 161000 V., 1200 amps., 60 cy., 3 ph., Type GO-3, Interr. Duty 1,500,000 KVA.

Fully complete—Cond. like new.

Price and further inf. upon request.

PHILADELPHIA TRANSFORMER CO.
Box 566 Dalton, Pa.

HIGH PRESSURE WESTINGHOUSE TURBINE-GENERATORS
IMMEDIATELY AVAILABLE

1—10,000 KW at 70% P..F., 600 PSIG, 750 Deg. FTT, 12,000/13,200 V. Installed 1947.

1—5000 KW at 70% P.F., 600 PSIG, 750 Deg. FTT, Automatic extraction at 30 PSIG, 12,000/13,200 V. Installed 1942.

Complete with Surface Condensers and all Auxiliaries.

CHARLES WEAVER, M.E.
19701 James Couzens Highway, Detroit 35, Michigan
Telephone: Broadway 3-1901

FOR SALE

4—760 H.P. B.&W. Cross Drum Sectional Header Boilers. 1930. 230 lbs., 24 sections, 14 tubes high, 54 inch Cross Drum.
3—Fully automatic Richardson Coal Scales with Track. 200 lbs per minute, 6 tons per hour.
1—6'x12' Welded Lead Lined Sulphuric Tank.
3—Permutit Softeners, each rated 90,000 gallons between regenerations. Contains Zeocarb.
1—500 g.p.m. Pump, direct connected to 1—20 HP 3/60/220/440 motor. 100' Head.
Approximately 400 HP in motors 5HP to 50 HP.
3—Gravity Filters, 8' x 10'.
1—24' x 12' Condenser with Brass Tubes, used in Clorox Process.
1—Complete Gasoline Cracking Plant.
1—Complete Asphalt Rerun Plant. Mfg. by Kellogg.
4—Open Tanks, 20' dia x 25 high, ¼" plate. 1 with agitator.
1—1000 c.f.m. steam-operated Ingersoll-Rand Air Compressor, 2 cylinder, steam pressure 200 lbs. to 150 lbs., air pressure 85 to 125 lbs., steam rate 27 lbs. with 20 lbs. back pressure. Built 1945.
1—150,000 lbs. per hour Cochrane Deaerating Heater, 20 lbs., 1949, with supports.
1—750 HP, 450 lbs. w.p. Riley RO Boiler complete with instruments and Peabody Burners water wall job with casing and tile.
1—150 HP, 1947, 125 w.p. International Water Tube Intergrow Boiler.
The following TRUMBULL Seeder duct
350', 1600 ampheres
200', 2000 ampheres
130', 1350 ampheres
Above with elbows and offsets.
1—Boiler Feed Pump direct connected to coffin turbine 200 g.p.m. Designed for 450 lbs. can be used for any pressure. Minimum steam required—150 p.s.i.
1—1000 g.p.m. Water Pump direct connected to a 30 HP 3/60/220/440 motor. 120' head.
1—750 g.p.m. Water pump, direct connected to a 25 HP 3/60/220/440 motor. 80' head.

SHERB PLANT CONSTRUCTORS, INC.
342 Madison Ave., New York 17, N. Y.
Telephone Murray Hill 2-9098

AIR COMPRESSOR

Ing.-Rand 14½" x 14½" x 10", Type XRE, low press. 35#, 1370 CFM, 1 stage, 360 RPM, W/150 H.P. Whse. sync. motor 3 ph., 440 V., shaft mounted, new 1952, fully complete.

Further inf. upon request.

PHILADELPHIA TRANSFORMER CO.
Box 566 • Dalton, Pa.

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

***Also*—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.**

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

IMMEDIATE DELIVERY

3—TRANSFORMERS—500 KVA, 1/60/2300-4000Y to 230/460, Whse., OISC, Modern Steel Cases. Cash for your surplus electrical equipment.

BENSON-WILIMZIG, INC.
1704 North 8th St. St. Louis 6, Mo.
Phone GArfield 1-4290

TURBO-GENERATORS

2500 KW Whse. Cond. 3/60/2400 V.
3600 RPM 400 PSIG 750°
1500 KW Ell. Cond 3/60/2400/4150 V
3600 RPM 400 PSIG 750°
1500 KW Elliott, Non-C. 3/60/480 V.
3600 RPM 240 PSIG 600° 50# BP
300 KW G.E. Non-C. 3/60/480 V.
3600 RPM 150 PSIG 5# BP

Full line power equipment

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

COMPLETE POWER PLANT

Turbo-Generator Set complete with Boilers, Condenser, Coal Handling Equipment, etc.

1—7500 KW G.E. Turbo-Generator Set, Condensing Type, 210#, 3/30/2300 volts, 1800 rpm, built approx 1925
4—600 HP B&W Water Tube Boilers, 212# with Stokers
1—Condenser (Worthington, 13,500 sq ft.)
Coal Handling Equipment (including Feeder, Crusher, Bucket Carrier, Belt Conveyor, etc.)

BERNSTEIN BROTHERS
(Since 1890)
100 N. Mechanic St., Pueblo, Colo.

NEW BOILERS

James Leffel Scotch—150 PSIG.

1—175 H.P. with or without stoker
1—125 H.P., no firing equipment

Boilers have never been fired. Can be supplied with any type burner equipment

Contact:

GAS EQUIPMENT ENGINEERS, INC.
501 Randolph St., N.E., Knoxville 17, Tenn.
Tel.—4-1871

ROSS COOLER

Model 860—all copper shell—Cupro-nickel tubes. 8" diam. shell—60" between tube sheets. Total cooling surface—64 sq. ft. For diesels to 500 HP.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
Baltimore 2, Md.—Lexington 9-1900

FOR SALE—IMMEDIATE DELIVERY

400 KW Terry non-condensing turbine, 325-400# PSI, 110-125# gauge back pressure, 3800 RPM, direct connected through reduction gear to a:
500 KVA—400 KW at 80% P.F., Allis Chalmers generator, 3 phase 60 cycle, 480 volts, 1200 RPM, excellent condition, complete installation equipped with direct connected exciter, switchboard with instruments and spare parts.

UTILITIES MACHINERY CORPORATION
1965 East Sixth St., Cleveland 14, Ohio

BOILERS FOR SALE—SIX MONTHS OLD

Two used Keeler water-tube portable boilers. Instruments, header valves, safety valves, condensate return tank. 10,000 lbs per hour 160 psi, built 1956 used 6 months. Can inspect in Paterson, N.J. Price: $12,500.00 net each boiler subject prior sale. Write

NAZZARO
12 South Mountain Ave., Montclair, N. J.
Phone after six Pilgrim 4-2956

BOILERS

Titusville ScotchMarine—150 H.P. 15 lb. #6 Oil
Package Water Tube—125 H.P. 125 lb. #6 Oil
York Shipley Package—30 H.P. 15 lb. #2 Oil
Keeler C.P.—250 H.P.—160 lb. W.P.

JOSEPH KRAUSS, INC.
P.O. Box 95, Ramsey, N. J.

FOR SALE — G.E. SWITCHES

2 NEW THROWOVER SWITCHES, 300A, 480 Volt 60 Cycle, 480 Volt. Emergency Cat. No. C.R.7896A2. In Original Crates—MAKE OFFER.

ONEIDA LTD., Oneida, New York

FOR SALE
DIESEL POWER PLANTS

2—Chicago Pneumatic, 6 cyl. Diesel Engines, Stationary Type, Circulating Water Cooled. Bore 8" Stroke 10½". Type 68CP, 180 H.P. 600 R.P.M. or 225 H.P. at 720 R.P.M.

1—Buda Diesel, 6 cyl. 1200 R.P.M. Model 8-D.C. 1290. Bore 5⅜" Stroke 6½". Circulating Water Cooled, w/125 K.V.A. A.C. Generator, 3 ph. 60 cyc. 1200 R.P.M. 240 volts, and Exciter. Mounted on steel base.

Price and further info. on request

PHILADELPHIA TRANSFORMER CO.
BOX 566
DALTON, PA.

FOR SALE BY OWNER

★ 120 KW Crocker-Wheeler alternator, 240 volts, 3 phase, 60 cycles, 225 RPM direct connected to Chuse 16" x 19" Corliss engine. Complete with exciter and switchboard (Wisconsin)

★ 300 KW G.E. alternator, 480 volts, 3 phase, 60 cycle, 200 RPM direct connected to Skinner Unaflow engine 22½" x 24", complete with exciter and switchboard (Michigan)

★ 250 KW Westinghouse alternator, 440 volts, 3 phase, 60 cycles, 200 RPM, direct connected to Nordberg Unaflow 18½" x 22" engine, complete with exciter and switchboard (Idaho)

★ 175 KW Electric Machinery Co. alternator, 230 volts, 3 phase, 60 cycles, 225 RPM, direct connected to Skinner Unaflow, 18" x 20", complete with exciter (Ohio)

★ 140 KW G.E. alternator, 240 volts, 3 phase, 60 cycles, 225 RPM, direct connected to 17" x 20" Skinner Unaflow engine, complete with exciter and switchboard (Wisconsin)

★ 250 KW Westinghouse alternator, 240 volts, 3 phase, 60 cycles, 200 RPM, direct connected to Nordberg Unaflow engine, 18" x 24", complete with exciter and switchboard.

For further information, contact:

CARNATION CO.
Engineering Department
5045 Wilshire Blvd. Los Angeles, Calif.

OPPORTUNITIES!

in

New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

Send for new list . . . to

EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE
Two Rector St., New York 6, N. Y.

look for the WAGNER GREEN TAG CERTIFICATION

It's your guarantee that the equipment you buy is as perfect in workmanship as the day it left the factory.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
200	Cr. Wh. b.b.	CMC-81H	230	1150
175	Cr. Wh.	151-H	230	800
150	Whse.	SK-184	230	850
100	Reliance	651-T	550	1000/1800
100	Reliance	651-T	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Century	R-92	230	690/1350
60	G.E. TEFC b.b.	CD-135	230	1150
60	G.E.	CD-113	230	1150
50	Gen. Elec.	CD-95	230	1800
50	Star b.b.	SQ-92	230	880
50	G.E.	CD-125	230	400/1200
40	G.E. (2)	CD-93	230	1750
30	Whse. (2)	SK-151	230	250/1000
25	L.A. TEFC b.b.	RNA	230	650

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	2200 AC	250 DC
300	Whse.*	2200/440 AC	600 DC
250	Cr. Wh.*	2300/4000 AC	250 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.	2300 AC	250 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Whse.	220/440 AC	250 DC
75	G.E. converter	440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC
30	G.E.	220/440 AC	125 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
175	Cr. Wh. b.b.	CCD	250	1450
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	850
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Century	R-92	250	900
60	Allis Ch. (8)	E-146	250	1500
60	Ideal	D	125	1150
35	G.E.	RC-34	125/250	900

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
600	G.E.	Slipring	2300	600
500	Whse.	Slipring	2200	450
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
350	G.E.	Sq. Cage	2200	1800
350	Cont. b.b.	Slipring	2300	900
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/400	600
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	440	450
300	Allis Ch.	Sq. Cage	2200/440	720
250	Ideal	Slipring	2200	900
250	G.E.	Slipring	440	1800
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	Whse.	Slipring	440	1200
250	G.E.	Sq. Cage	2200	1800
250	Allis Ch.	Synch.	440	360
225	G.E.	Synch.	220/440	900
200	G.E. (2)	Sq. Cage	2200/440	1200
200	Whse. (2)	Slipring	2200	514
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G.E.	Sq. Cage	440	600
175	G.E. (2)	Synch.	220/440	720
150	El. Machy.	Synch.	220/440	360
150	G.E. (4)	Slipring	2200/440	600
150	G.E. (2)	Sq. Cage	2200/440	720
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E.	Slip Ring	220/440	450
125	Whse. TEFC	Sq. Cage	2200/440	720
125	G.E. TEFC	Sq. Cage	2300	3600
125	Ideal	Slipring	4000/2200	900
100	Al. Ch. TEFC	Sq. Cage	2200/440	720

TRANSFORMERS—3—150KVA Kuhlman OISC, 1 ph. 60 cycle, 2400—240/480, late type.

THOUSANDS OF MOTORS & GENERATORS IN STOCK

AC & DC . . . all sizes and types up to 1000 H.P. . . . all covered by the WAGNER guarantee.

Arthur Wagner Co. Certified

MO nroe 6-7409
1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS

DIESEL ENGINES — POWER MACHINERY

100 KW to 1500 KW

Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

A. G. SCHOONMAKER COMPANY, INC.

MAIN OFFICE: Box 516, Sausalito, Calif. Sausalito 1600
BRANCH: 50 Church St., N. Y. 7, N. Y. Digby 9-4350

COMPRESSOR DIRECTORY

World's Best Rebuilts

18 CFM	3500 PSI	Ing 30 New
136 CFM	100 PSI	7x7 Ingersoll ESI
268 CFM	500 PSI	10-4½x10 Ingersoll XOB
284 CFM	100 PSI	Chic. PE 50 HP
437 CFM	40 PSI	12x9 Ing ESI (New)
440 CFM	50 PSI	13x10 Worth—all-less
552 CFM	100 PSI	13-8"x12 Ingersoll XRB
502 CFM	125 PSI	12x13 Chic T
676 CFM	100 PSI	13-9½x12 Ing XRB
593 CFM	100 PSI	13½-8x8 IR-XRE
868 CFM	100 PSI	17—10x12 CP-OCE
1270 CFM	40 PSI	19x13 Ing. ESI
1723 CFM	110 PSI	140 lbs. at Ingersoll XPV
5748 CFM	50 PSI	29-29x24 IR—PREI

Portables—60 CFM to 600 CFM

American
AIR COMPRESSOR CORP.
DELL AVE. & 47th ST.
NORTH BERGEN, N.J.
Telephone UNion 5-4848

80000#/HR. BOILER

ERIE CITY Type 1-W-T BENT WATER TUBE 3 drum 250 PSI W.P.; Built 1948; 8100 sq. ft. heating surface; 1370 sq. ft. water wall surface; steel encased; Rotograte spreader stoker; forced and induced draft fans; dust collectors; Thermix stack. Used only 2 years.

75000#/HR. BOILER

COMBUSTION ENGR. CO. 4 drum STIRLING Type BOILER 400 PSI W.P.; pulverized coal fired; forced and induced draft fans; superheater, waterwalls.

WATER SOFTENING PLANT

Cochrane Feed Water Heater and Softener complete with demineralizer, cation and anion exchangers, regenerating equipment, decarbonator, sedimentation tanks, filters, controls, etc. to deliver 24000 GPH hot soft water.

HEAT & POWER CO., INC.

60 E. 42nd St., New York 17, N. Y.
Murray Hill 7-5280
(Machinery & Equipment Merchants)

ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

Air Preheater Corp. ... 259
Airetool Mfg. Co. ... *
Alco Prducts, Inc. ... 263
Allen-Sherman-Hoff Co. ... Second Cover
Allgemeine Elecktricitats-Gesellschaft ... *
Allis-Chalmers Mfg. Co. ... 26-27, 52-53, 139, 181, 191, 201
Allpax Company, Inc. ... *
Aluminum Company of America ... 229
American Blower Corp. ... 24-25
American Gilsonite Co. ... *
American Pulverizer Co. ... 276
Ames Iron Works, Inc. ... *
Anchor Packing Co. ... 209
Arkansas Fuel Oil Co. ... 70
Armstrong Cork Company ... 219
Armstrong Machine Works ... 149
Atomics International, Div. of North American Aviation, Inc. ... *
Automatic Switch Company ... 277

Babbitt Steam Specialty Co. ... *
Babcock & Wilcox Co. ... 6-7
Babcock & Wilcox Co. (Refractories Div.) ... 51
Babcock & Wilcox Co. (Tubular Products Div.) ... *
Babcock & Wilcox Co. (Tubular Products Div., Fittings Dept.) ... 268
Badger Mfg. Co. ... 245
Bailey Meter Co. ... 12-13
Baldwin-Hill Co. ... *
Baltimore & Ohio Railroad ... 161
Bell & Gossett Co. ... *
Belmont Packing & Rubber Co. ... 198
Biddle Co., James G. ... 230
Bigelow Co. ... 184
Bingham Pump Co. ... 186
Bituminous Coal Institute ... 264
Black, Sivalls & Bryson, Inc. ... 180
Blaw-Knox Co. Power Piping & Sprinkler Div. ... 278
Boiler Tube Co. of America ... 216
Bonney Forge & Tool Works ... *
Bridgeport Brass Co. ... *
Brown Boveri Corp. ... 269
Buell Engineering Co. ... 192
Buffalo Forge Co. ... 38-39, 255
Buffalo Pumps, Inc. ... *
Burgess-Manning Co. Penn Instruments Div. ... 306
Bussmann Mfg. Co. ... *
Byers Company, A. M. ... 297
Byron Jackson Pumps, Inc. ... 237

Carey Mfg. Co., Philip ... 58-59
Cash Co., A. W. ... *
Catawissa Valve & Fittings Co. ... 226
Caterpillar Tractor Co. ... 221
Celanese Corp. of America (Chemical Div.) ... 262
Chapman Valve Mfg. Co. ... 250
Charleston Rubber Co. ... 218
Chesapeake & Ohio Railway ... 283
Chesterton Co., A. W. ... 182
Chicago Pneumatic Tool Co. ... *
Chicago-Wilcox Mfg. Co. ... *
Childers Mfg. Co. ... *
Cities Service Oil Co. ... 70
Clarage Fan Co. ... 189
Clark Bros. Co. ... 227
Cleaver-Brooks Co. (Boiler Div.) ... 273
Cleveland Controls ... 216
Cochrane Corporation ... *
Combustion Engineering, Inc. ... 40-41
Condenser Service & Engrg. Co. ... *
Cook's Sons, Inc., Adam ... *
Cooper-Bessemer Corp. ... 271
Copes-Vulcan Div., Blaw-Knox Company ... 14-15
Coppus Engineering Corp. ... 147
Corning Glass Works ... 236
Crane Company ... 167
Crane Packing Company ... 212
Crawford Fitting Co. ... 242
Curtiss-Wright Corp. ... *
Cyclotherm Div., National-U.S. Radiator Corp. ... 188

Darling Valve & Mfg. Co. ... *
Deady Chemical Co. ... *
Dearborn Chemical Co. ... 295
DeLaval Steam Turbine Co. ... 2
Deming Company ... 204
Detroit Controls Corp. ... *
Detroit Stoker Co. ... 233
Diamond Power Specialty Corp. ... 8-9, 165
Dodge Mfg. Corp. ... *
Dow Corning Corp. ... 284
Dow Chemical Co. ... *
Dowell, Inc. ... 179
Dravo Corporation ... *
Dwyer Mfg. Co., F. W. ... 304

Eagle-Picher Co. ... 305
Eastern Constructors, Inc. ... 304
Edison, Inc., Thomas A. ... *
Edward Valves, Inc. ... 44-45
Electric Machinery Mfg. Co. ... *
Electric Storage Battery Co., Exide Industrial Div. ... *
Elgin Softener Corp. ... 185
Elliott Company ... 239
Engineer Company ... *
Equipto Div. of Aurora Equip. Co. ... *
Erico Products, Inc. ... *
Erie City Iron Works ... 46-47

Fairbanks Co. ... *
Fibreboard Paper Prods. Corp., Pabco Ind. Insulations Div. ... 197
Fisher Governor Co. ... 253
Flexible Steel Lacing Co. ... 224
Flexitallic Gasket Co. ... *
Fluor Products Co. ... 187
Foster Engineering Co. ... *
Foster Wheeler Corp. ... 18-19, 153
Foxboro Company ... *
Frick Company ... *
Fuller Company ... 114

Garlock Packing Company ... 35
Gates Rubber Co. ... *
General Electric Co. (Apparatus Dept.) ... 16-17, 145
General Electric Co. (Circuit Protective Devices Dept.) ... *
General Motors Corp., Electro Motive Div. ... 30-31
Goodrich Industrial Products Co., B. F. ... 320
Goulds Pumps, Inc. ... 240
Graver Tank & Mfg. Co., Inc. ... *
Green Fire Brick Co., A. P. ... *
Grinnell Company ... Third Cover
Gulf Oil Corp. ... 28-29

Hagan Chemicals & Controls, Inc. ... 291
Hall Laboratories ... *
Harbison-Walker Refractories Co. ... *
Harco Corp. ... 306
Hays Corporation ... *
Hewitt-Robins ... 210
Heyl & Patterson, Inc. ... *
Hilliard Corp. ... *
Hoffman Specialty Mfg. Corp. ... 243
Hoke Incorporated ... *

I-T-E Circuit Breaker Co. (Switchgear Div.) ... 256
Illinois Water Treatment Co. ... *
Infilco Inc. ... 307
Ingersoll-Rand Co. ... 55, 199
International Nickel Co., Inc. ... 299
Iron Fireman Mfg. Co. ... 281
Irving Subway Grating Co., Inc. ... *

Jeffrey Mfg. Co. ... 292
Jenkins Bros. ... 156-157
Jerguson Gage & Valve Co. ... *
Johns-Manville ... 163
Johnson Service Co. ... 303
Jones & Laughlin Steel Corp. ... *
Joy Mfg. Company ... 260

Kaiser Aluminum & Chemical Sales, Inc. ... 289
Keasbey & Mattison Co. ... 290
Keeler Company, E. ... 231
Kennedy Van Saun Mfg. & Engrg. Corp. ... 72-73
Kewanee Boiler Div. ... *
Kieley & Mueller, Inc. ... 174
Kirk & Blum Mfg. Co. ... 190
Klinger, Ltd., Richard ... 203
Koppers Co., Inc. (Aeromaster Fans) ... 214
Koppers Co., Inc. (Coupling Dept.) ... *
Koppers Co., Inc. (Industrial Gas Cleaning Dept.) ... 287
Koppers Co., Inc. (Piston Ring & Seal Dept.) ... *
Kuljian Corporation ... *

L A Water Softener Company ... *
Laclede Stoker Co. ... *
Layne & Bowler Pump Co. ... *
Leeds & Northrup Company ... 272
Leslie Company ... 308
Link-Belt Company ... 1

Lockett & Company, Ltd., A. M. 214
Lunkenheimer Company 265

Manning, Maxwell & Moore, Inc. 54, 64-65, 261, 296
Marley Company 213
Marsh Instrument Co. 282
Maryland Shipbuilding & Drydock Co. ..... *
Mason-Neilan Regulator Co. ..... *
McDonnell & Miller, Inc. ..... *
McGraw-Hill Book Co. 226
McNally Pittsburgh Mfg. Corp. 202
Mercoid Corp. ..... *
Midcontinent Tube Service, Inc. 309
Midwest Piping Co., Inc. 215
Minneapolis-Honeywell Regulator Co., Industrial Div. 60-61
Minnesota Mining & Mfg. Co. ..... *
Monsanto Chemical Co. Organic Chemicals Div. 50
Morton Salt Co. 235
Murray Iron Works Co. 195
Murray Mfg. Co., D. J. ..... *

National Airoil Burner Co., Inc. 238
National Aluminate Corp. 155, 222
National Tube Div. ..... *
Niagara Blower Co. 218
Nicholson & Co., W. H. 279
Nordberg Mfg. Co. 207
Norton Company ..... *

Ohio Brass Co. 217
Ohio Injector Co. ..... *
Okonite Co. 49
Owens-Corning Fiberglas Corp. 169

Panellit, Inc. ..... *
Parker Appliance Co. 220
Peabody Engineering Corp. ..... *
Peerless Pump Div. Food Machy. & Chemical Corp. 275
Pennsylvania Flexible Metallic Tubing Co. ..... *
Pennsylvania Pump & Compressor Co. ..... *
Permutit Company 56-57
Perolin Co., Inc. ..... *
Philadelphia Gear Works, Inc. 293
Phoenix Mfg. Co. (Flange & Forging Div.) ..... *
Pittsburgh Piping & Equipment Co. 74
Powell Co., Wm. 193
Powers Regulator Co. ..... *
Pratt Company, Henry 274
Preferred Utilities Mfg. Corp. ..... *
Pritchard & Co., J. F. 298

R-P & C Valve Div., Amer. Chain & Cable 223
Raybestos-Manhattan, Inc. Manhattan Rubber Div. ..... *
Raybestos-Manhattan, Inc. Packing Div. 194
Reliance Gauge Column Co. ..... *
Republic Flow Meters Co. 20-21
Republic Steel Corp. ..... *
Research-Cottrell, Inc. 173
Revere Copper & Brass, Inc. 171
Ric-Wil Incorporated 286
Ridge Tool Company 246
Riley Stoker Corporation 112-113
Ross Heat Exchanger Div. ..... *
Roto Div. of Elliott Co. 200

Sarco Company 159
Sargent & Lundy Engineers ..... *
Scam Instrument Corp. 224
Schaub Engrg. Co., Fred H. ..... *
Scovill Mfg. Co. ..... *
Sinclair Refining Co. 241
Smith Company, S. Morgan 285
Smith Corporation, A. O. 42-43
Socony Mobil Oil Co., Inc. 22-23
Solar Aircraft Co. 254
Southwestern Engineering Co. 234
Speedline Fittings Div., Horace T. Potts Co. 302
Spence Engineering Co. ..... *
Standard Oil Co. of Indiana 151
Steiner Nuclear Services 236
Stephens-Adamson Mfg. Co. 36-37
Stickle Steam Specialities Co. ..... *
Stillwater Clay Products Co., Stillwater Conduit Div. ..... *
Stock Equipment Co. 177
Stone & Webster Engrg. Co. ..... *
Stow Manufacturing Co. 196
Sylvania Electric Products, Inc. Atomic Energy Div. ..... *

Taylor Instrument Companies 32
Taylor & Company, W. A. ..... *
Terry Steam Turbine Co. 247
Texas Company 4
Titusville Iron Works Co., Div. of Struthers-Wells Corp. ..... *
Todd Shipyards Corp., Products Div. 248
Troy Engine & Machine Co. ..... *
Tube-Turns, Inc. ..... *

Union Asbestos & Rubber Co. 252
Union Engineering Corp. 232
Union Iron Works 66-67
United States Gauge ..... *
United States Rubber Co. (Mechanical Div.) 280
United States Steel Corp. 249
Universal Atlas Cement Co. 258

Vapor Heating Corp. 257
Viking Pump Co. 232
Virginia Gear & Machine Corp. 293
Vogt Machine Co., Henry 211

W-S Fittings Div. H. K. Porter Company, Inc. ..... *
W-K-M Div. of ACF Industries ..... *
Wallace & Tiernan Inc. ..... *
Walworth Company 270
Warren Pumps, Inc. 244
Western Chemical Co. 208
Western Precipitation Corp. 288
Westinghouse Electric Corp. 48, 62-63
Westinghouse Electric Corp. (Sturtevant Div.) 68-69
Wheeler Mfg. Co., C. H. 183
Where to Buy 309
Wickes Boiler Co. 225
Wiedeke Co, Gustav ..... *
Wilson, Inc., Thomas C. 302
Wing Mfg. Co., L. J. ..... *
Worthington Corp. Back Cover, 33-34, 266-267
Wright-Austin Co. 206

Yarnall-Waring Company 10-11, 141, 205
Yeomans Bros. Co. 228
York-Shipley, Inc. 251

Zallea Brothers ..... *
Ziegler & Co., G. S. 294

Professional Services 309

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 310
EDUCATIONAL 311
EQUIPMENT
(Used or Surplus New)
For Sale 311-317
WANTED 311

ADVERTISERS INDEX

Ajax Electric Motor Corp. 311, 312
Aljon Electric Diesel Co. 311
American Air Compressor Corp. 317
American Electric Service & Maintenance Co. 314
American Hoist & Derrick Co. 314
Belyea Co., Inc. 312
Benson-Wilimzig Co., Inc. 316
Bernstein Brothers 316
Boston Metals Co., Inc. 313, 315, 316
Brew-Woltman & Co., Inc. 316
Burns & Roe, Inc. 310
Carnation Co. 317
Chicago Electric Co. 315
City Water & Electric Dept., Dyersburg, Tenn. 314
Continental Corp. 314
Dell Stephenson & Co. 312
DeRose, G. M. 316
Ebasco Services, Inc. 317
Electric Equipment Co. 315
Electric Service Co., Inc. 314
Ellis Co., A. Lee 312
Foster Co., L. B. 312
Gas Equipment Engineers, Inc. 316
Granby Consolidated Mining, Smelting & Power Co., Ltd., The 315
H & P Machinery Co. 313
Hall & Co., Stephen 314
Heat & Power Co., Inc. 314, 317
Hemphill & Co., Inc 312
Kaiser-Nelson Co., The 312
Krauss, Inc., Joseph 316
Lefax 311
Machinery Expediters 311
National Metal & Steel Corp. 313
Nazzaro 316
Neu Corp, Hugo 311, 314
Oberman, Paul 311
Oneida, Ltd. 316
Philadelphia Transformer Co. 315, 316, 317
Schoonmaker Co., Inc., A. C. 317
Sherb Plant Contractors 316
Slade 311
Sorensen Governor Service 312
Soul Clinic, Inc. 311, 314
Utilities Machinery Corp. 316
Wabash Power Equipment Co. 313
Wagner Co., Arthur 317
Wahlfield Manufacturing Co. 314
Walker & Collins 311
Weaver, Charles 313, 315, 316
Whisler Equipment Co. 314

B.F.Goodrich report:

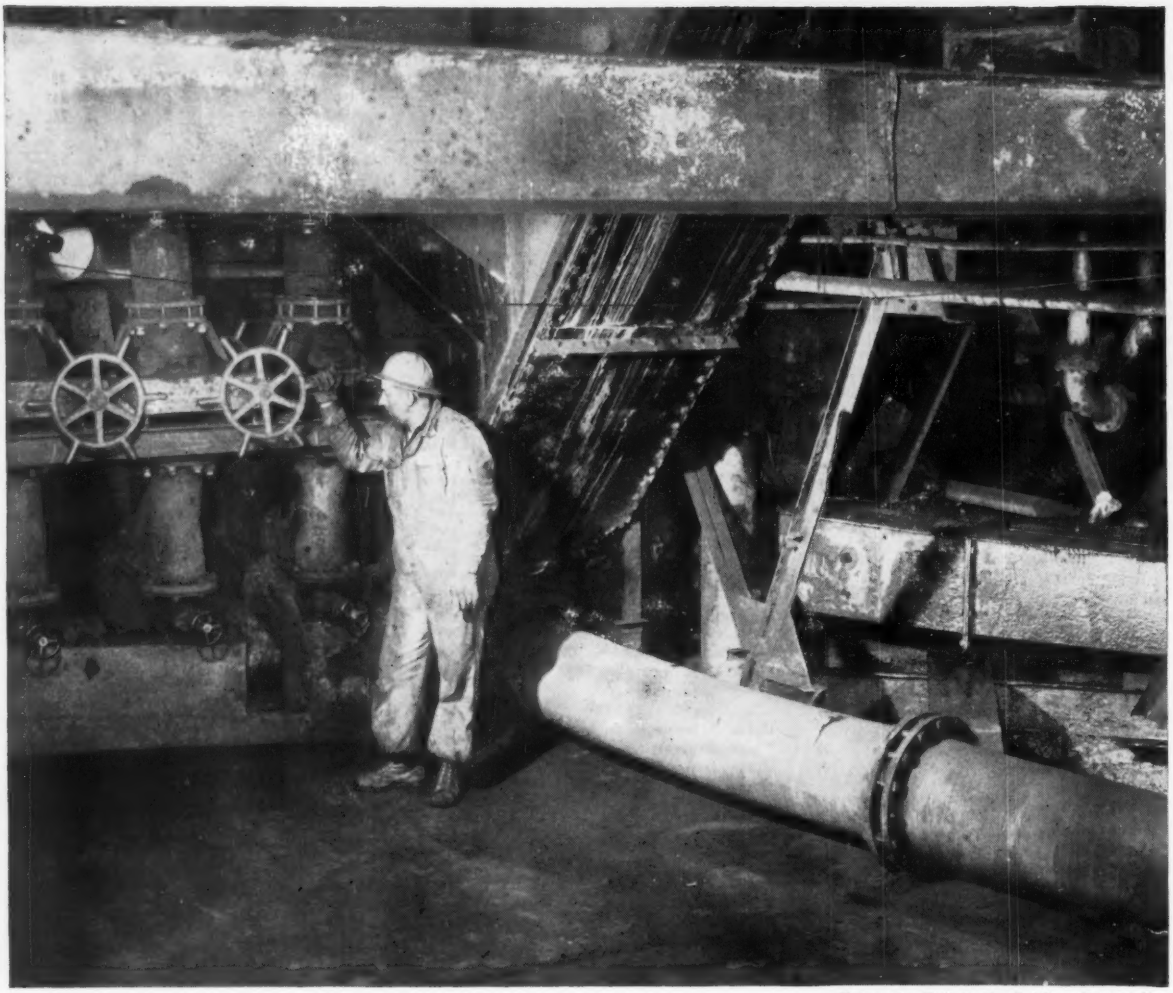


Photo courtesy North American Coal Corp., Cleveland, Ohio

Hose swallows needle-sharp slivers of coal

B. F. Goodrich improvements in rubber brought extra savings

Problem: At this mine, coal is put through a huge washing machine that shakes rock and sand out of the coal, much like a home washer shakes dirt out of clothes.

The water—8000 gallons of it a minute—used to be circulated in and out of the coal washer by steel pipes. But the water is loaded with tiny particles of coal—hard and sharp, like needles—that wore holes right through the steel. Welders worked every weekend, patching holes. The pipe was being replaced every year.

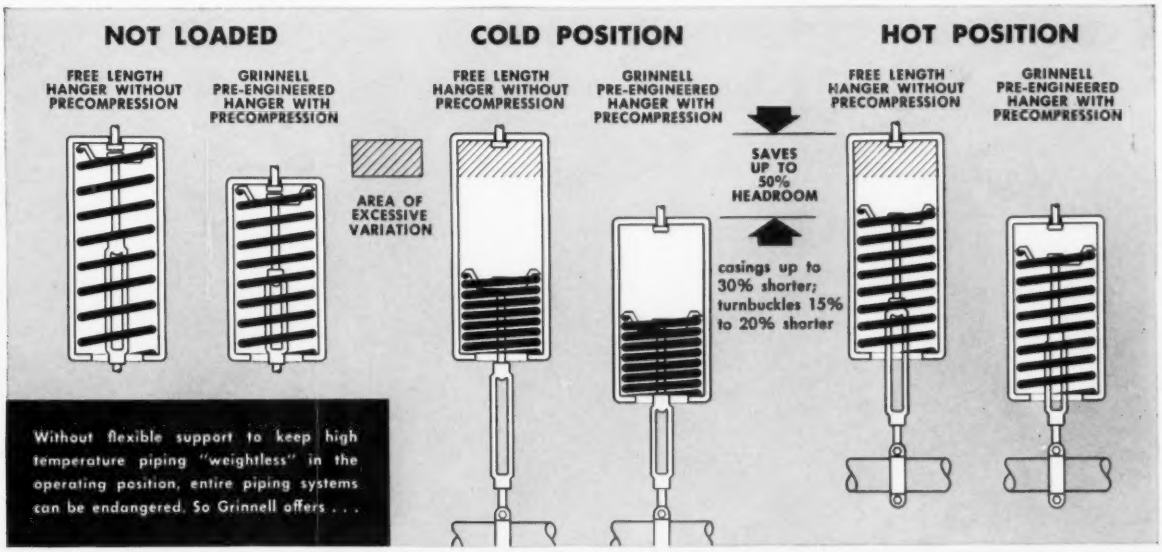
What was done: When a B.F.Goodrich distributor heard about the trouble, he suggested a rubber hose developed by B.F.Goodrich for handling rough materials. It is made with a special lining of the toughest wear-resisting rubber known. This rubber is so tough that, on many jobs, it outlasts the hardest steel 10 to 1.

Savings: The B.F.Goodrich rubber hose was tried. You see one big length of it at right in the picture. It has been on the job over 4 years now, and is still in excellent condition. No holes, no repairs, no problems of any kind.

Where to buy: Your B.F.Goodrich distributor has exact specifications for the B.F.Goodrich hose described here. And, as a factory-trained specialist in rubber products, he *can* answer your questions about *all* the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-926, Akron 18, Ohio.*

B.F.Goodrich

INDUSTRIAL PRODUCTS


NOT LOADED
COLD POSITION
HOT POSITION
FREE LENGTH HANGER WITHOUT PRECOMPRESSION
GRINNELL PRE-ENGINEERED HANGER WITH PRECOMPRESSION
AREA OF EXCESSIVE VARIATION
SAVES UP TO 50% HEADROOM
casings up to 30% shorter; turnbuckles 15% to 20% shorter
Without flexible support to keep high temperature piping "weightless" in the operating position, entire piping systems can be endangered. So Grinnell offers . . .

Precompressed Hangers for Safer Support of Piping

Helical coil springs are widely used in hangers for flexible support of piping which moves up or down during thermal expansion. The A.S.A. code for pressure piping requires that variable spring hangers support at least a minimum of 75% of the pipe's weight for a pipe that rises (relaxing the spring) and no more than 125% of the pipe's weight for a pipe that lowers (compressing the spring) during operation.

Precompression patented Grinnell principle

To guard against the spring's supporting force exceeding the limits of variation, Grinnell developed and patented a variable spring hanger design. The steel casing holds the spring permanently precompressed, at the threshold of the hanger's working load range. This prevents the spring decompressing into its area of excessive variation.

Pre-set is not a substitute

As a partial substitute for this patented precompression, some manufacturers insert a spacer between the top end of a free-length hanger casing and the spring to hold the spring's height temporarily within the working range during shipment and erection.

Another device requires the manufacturer to drill symmetrically opposite holes in the casing walls and insert a bolt to hold the spring's height within the working range. When these devices are removed from the hanger and discarded, the spring can decompress, resulting in high variability in supporting force.

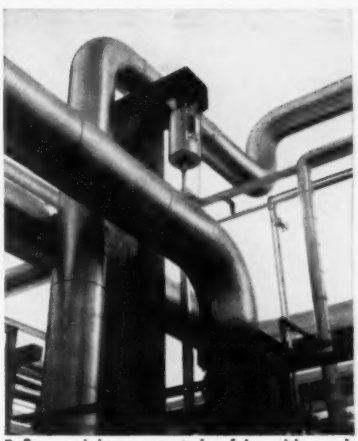
Cold-setting a universal factory service

For the erection crew to avoid having to compress the spring down to the erected position, the manufacturer can compress the spring down to this height. Grinnell can provide a cold-set bolt in precompressed hangers.

Less headroom required by Grinnell Hangers

Shorter hanger casings made possible by Grinnell's patented precompression, reduce bulk shipping weight and required headroom by eliminating undesirable height. Installation is simplified by this shorter casing and also by an integral load scale with load indicator.

Additional headroom is saved by a correspondingly shorter turnbuckle. These precompression advantages are available in short spring and double spring models as well as standard spring models.



Refinery piping supported safely, with ample flexibility but low headroom.

Available in 63 standard units

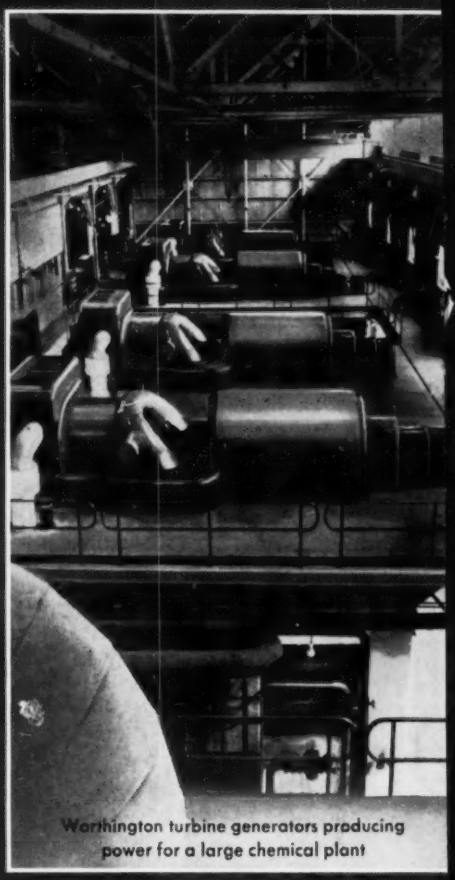
Grinnell Variable Spring Hangers are available in 21 sizes each of short, standard and double spring models . . . for maximum travel of 1¼, 2½ and 5 inches respectively within working load ranges. Load capacities extend from 43 lbs to 30,550 lbs. The maximum variation in the standard size per ½-inch deflection is 10½% of rated capacity; inversely proportional in short spring and double spring models.

For further information

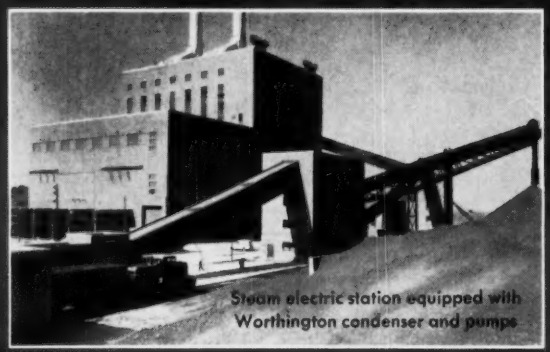
If you have a pipe suspension problem, you are invited to write: — Grinnell Company, Inc., 278 West Exchange Street, Providence, R. I.

Worthington equipment air conditions the Beverly Hilton hotel

keep your eye on



Worthington turbine generators producing power for a large chemical plant

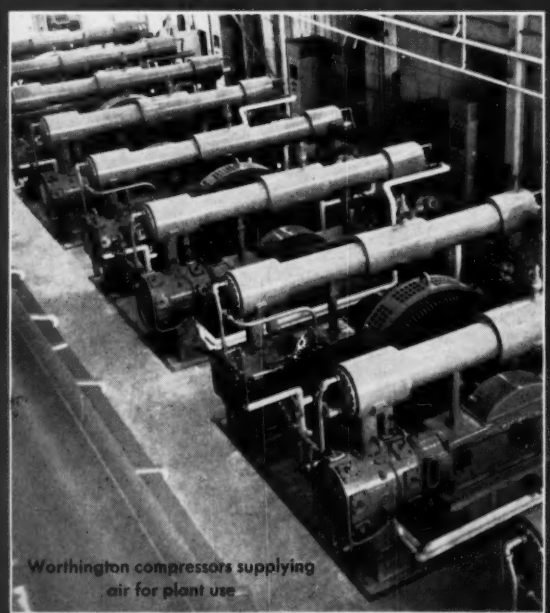


Steam electric station equipped with Worthington condenser and pumps

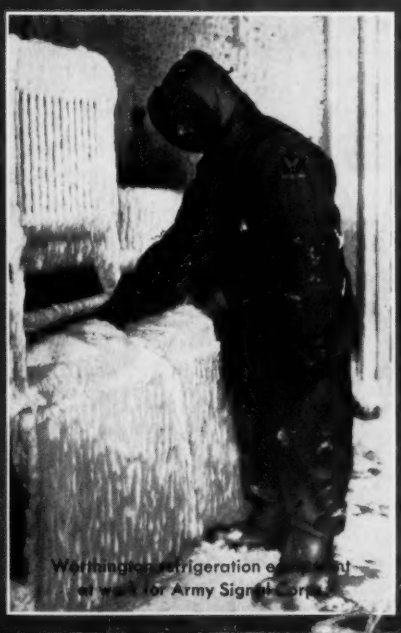
WORTHINGTON

Builder of equipment for all power services.

***General Offices*: Harrison, New Jersey**



Worthington compressors supplying air for plant use



Worthington refrigeration e[illegible] at work for Army Signal Corps

- Pumps
- Compressors
- Heating, Air Conditioning and Refrigeration Equipment
- Steam Turbines
- Steam Condensers
- Air Ejectors
- Engines
- Feedwater Heaters
- Construction Equipment
- Mechanical Power Transmission Equipment
- Positioning Equipment
- Industrial Mixers
- Liquid Meters
- Electric Motors
- Generators and Controls